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MODEL AIRPLANE NEWS

48120 August 1993

THE WO... MODELING MAGAZINE

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AUGUST 1993 VOLUME 121, NUMBER 8

MODEL AIRPLANE NEWS

FEATURES

ABOVE: *looking for an entry-level ARF glider? Ed Ducote poses with his Thunder Tiger Explorer 2M from Global Hobby Distributors.*

ON THE COVER: *the Toucan— a forward-swept flying wing designed by Larry Renger.*

FEATURES

CONSTRUCTION

COLUMNS

COLUMNS

DEPARTMENTS

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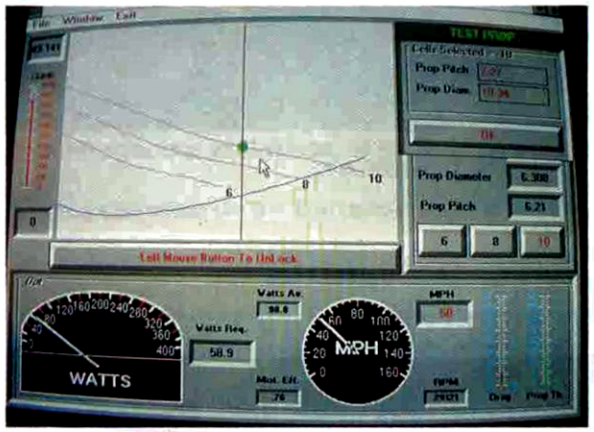
EDITORIAL

TOM ATWOOD

A NEW ERA FOR MODEL DESIGN

New computer programs are coming to market that open up whole new avenues to the model designer. Here I'll just briefly mention two. These programs give the inquisitive modeler tools that previously have been almost exclusively within the province of highly trained aerodynamicists, physicists and engineers. Such software lets you specify basic characteristics of an airplane such as its weight, drag, propulsion system, propeller and planform, and then helps you fine-tune these (and other) parameters to achieve precisely the flight performance in which you are interested.

Ideally, such a program would be written by an aeronautical engineer with many years of experience. Since sport modelers usually don't have much use for equations, the program would have to be very simple to use. To ensure its practical utility, the designer would, in the best of all worlds, have had many years of experience in the hobby. Wouldn't hurt if that person were also a major figure in the aerospace world. Say, the chief engineer behind the F-14 fighter bomber, one who was instrumental in the development of Grumman's Lunar Landing Module guidance and navigation system, and a pioneer of vertical-takeoff-and-landing (VTOL) aircraft. It may seem hard to believe, but such a person—Bob Kress, a former Grumman VP—is in fact the technical mind behind one of the programs. His son John performed all the programming. The program is called "Electroflight Design."



This screen is from a new program created by Bob and John Kress. The vertical axis (not labeled in this pre-production version) represents thrust (or drag), and the horizontal axis represents airspeed. The three upper curves, from top to bottom, represent 10-, 8- and 6-cell scenarios. The bottom curve represents drag. By moving the cursor around, the user can identify the rate of climb, airspeed, rpm, best prop diameter and pitch, and motor efficiency for different possible flight speeds. Suppose you want to see how your plane performs using a single prop. The pull-down menu at the top right lets you select a given pitch and diameter, and all the supporting data dynamically responds to that constraint as you move the cursor along a newly created fixed prop curve. The best climbing model exists near the low point of the drag curve. The fastest is where the thrust and drag curves intersect.

The second program is version 2 of USR&D's AERO*COMP (the initial release was reviewed in the November '92 issue of *Model Airplane News*). Staff members at USR&D hold advanced degrees in aeronautical engineering, electronics, physics and geophysics. They helped design the first camera that went to the moon, they had a hand in the design of electronics for the Minuteman missile, they programmed guidance systems for the Safeguard missile project, and they helped design fighter and photo recon aircraft for Uncle Sam. They also have a combined total of more than 7,500 hours as former USAF aircrew officers.

With credentials like these, it's no wonder both programs are as impressive as they are. Both programs relate to electric model performance. Both companies plan follow-on versions dealing with glow engines, ducted fans, and helicopters. Both programs calculate model drag and required horsepower, electric motor performance and model performance. Both can be used to determine optimal propeller diameter and pitch. And both can be used to simulate glow, gas, and ducted fan models—just specify prop size, RPM and aircraft characteristics.

Of course, the two programs also differ in some ways. A strong point of Electroflight Design is the interactive (mouse-driven) screen (see photo), which allows the user to get a feel for model performance by selecting points with a cursor, and its ability to recommend optimal propellers, in spreadsheet form, for all flight speeds. Strong points of the USR&D program include its motor select menu, which stores data from more than 100 motors that have been tested in USR&D's own laboratory, and its ability to work in either metric or English units of measurement.

NEW AVENUES

Although software for modelers is only beginning to catch on, it is the wave of the future. These programs allow you to optimize the performance of your models before you build them—a nice alternative to investing many hours in an aircraft that turns out to be a ho-hum performer in the air. They help you avoid damaging your expensive motor and radio equipment (not to mention your ego!) by keeping marginal aircraft on the ground. Experimenting with aircraft performance no longer requires tens of hours at the workbench and several at the flying field—it now only takes a few minutes on the computer. For further information, contact Kress Jets at (914) 336-8149; fax (914) 336-5975. USR&D can be reached at (908) 850-4131. ■

Bob (left) and John Kress.

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AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Rd., Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

METHANOL VS. GAS

I'd like to point out a couple of errors in your February '93 issue concerning the Unlimited Races. Rob Wood states on page 75 that "methanol has a higher power-to-weight ratio than gasoline, but twice as much is consumed in a 10-minute flight." This should have read: "methanol has roughly half the chemical energy of gas, so twice as much is consumed." This is confirmed by your data. Also, I believe you switched the fuel types in the shaded summary box. You have a great magazine. Keep up the excellent work.

TOM FEY
Arlington Heights, IL

Tom, thanks for catching the error. Rob Wood, author of the article, and Karl Risteen, an aeronautical engineer with extensive experience in methanol conversions of UAV engines, comment below.

Rob notes: "Tom Fey was right on the money in pointing out the inaccuracies in the comparison chart between Stinger Wallace's Stiletto (no. 47) and Don Rice's Mustang (no. 00). In the modem transfer of my article to Model Airplane News, some of the data was garbled, and was inadvertently transposed in printing. My thanks to Tom Fey and apologies to Stinger Wallace and Don Rice. All of the test results I have seen from methanol conversions show substantially higher engine performance. Here are some additional observations:

"Methanol requires less than half of the oxygen needed for combustion than does an equal volume of gasoline. By adding an oxygen booster, such as nitromethane to the fuel mixture, fuel consumption can be dramatically increased with a leaner needle setting, and rpm will increase. Our 4.4ci Husqvarna conversion swings an APC 22x12 at 7,900rpm on straight methanol with Klotz oil. By adding 8 percent nitro, the rpm increases to 8,400. Methanol also has a higher octane rating, which results in less detonation and a more controlled burn rate.

"Converting a chain-saw engine to methanol does have some drawbacks. These include increased weight (and attendant induced drag), greater expense and the need to modify the carburetor. The timing must be advanced to take advantage of the power increase from added nitro, and the compression may need to be reduced in order to use a tuned pipe. Methanol/nitro fuel is also more sensitive to changes in barometric pressure, air density, temperature, etc., than is gasoline. Whether or not it makes sense to convert 'old faithful' to methanol depends on the given situation and personal preference."

Since 1976, Karl Risteen has converted numerous chain-saw-derived engines (and larger—up to 125cc) to methanol with good results. Karl notes: "the methanol-versus-gasoline war has been heating up lately. Both fuels have their strengths and weaknesses. Methanol's advantages are cooler running, higher power and cleaner burning. Its chief disadvantage is its lower energy content per pound.

"Methanol, while it produces considerably higher power than gasoline in an engine with a properly adjusted carburetor, actually provides far less energy per unit mass or volume, but requires much less oxygen to burn. Chemically correct fuel/air ratios, by weight, for methanol and gasoline are 1:6.46 and 1:15.11 respectively.

"Burning a pound of methanol releases 9,600 Btu of heat versus about 19,500 for gasoline. Factoring in the much richer mixture, methanol will make available about 15 percent more energy with the correct fuel/air ratio than will gasoline, and this results in about 20 percent more power, assuming engine friction is unchanged.

"Methanol's need for a much richer mixture frequently requires carburetor modifications—usually drilling out jets. Many carbs intended for gasoline have gasket, diaphragm, etc., materials that are incompatible with methanol. Corrosion and rust are also problems with methanol as it is highly hygroscopic. (It attracts water like flies to a manure pile.)

(Continued on page 123)

AEROBATICS MADE EASY

DAVE PATRICK

EXPO, DUAL RATES AND MORE

THIS MONTH, we are discussing three radio functions that affect the amount of servo deflection that will result from a stick deflection on your transmitter: dual rate, variable-trace ratio and exponential. Using one or more of these can add performance and fun to your flying. The right choice or combination of these functions can be a tough question. But first, what the heck are they?!

Today's modern radios almost always have some form of these handy functions, yet their proper use seems to be a mystery to most fliers. Once they're understood, they're really quite easy to set up. You'll wonder why you haven't used them all this time!

FIRST, THE WHY

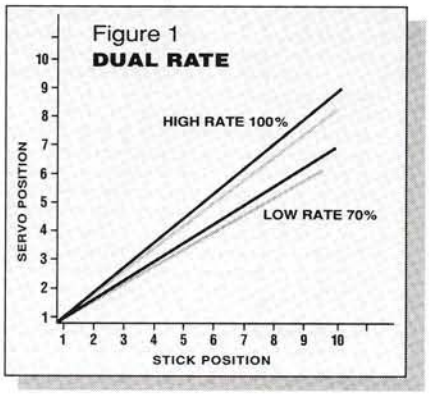
Whichever function is used, the object is to have the radio provide enough extra throw for certain maneuvers, e.g., a snap roll or a spin, and an alternative control-throw setting that will make it easier to perform the smoother maneuvers such as a slow roll. In other words, we are asking the radio to have a sensitive setting and a gentle setting at the same time.

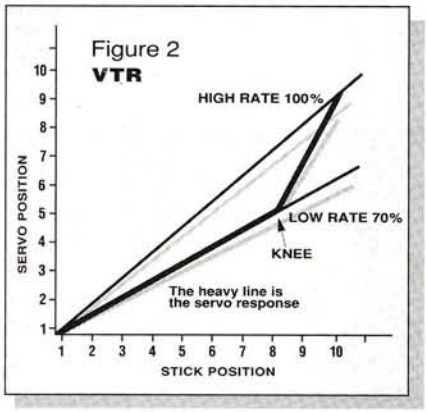
DUAL RATES

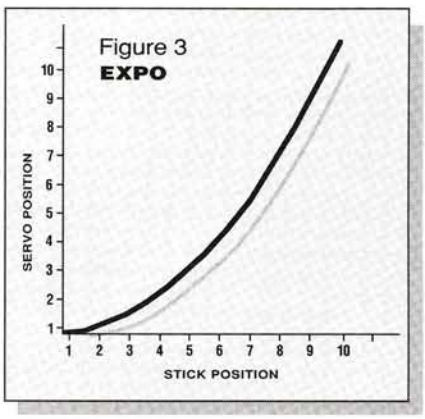
The most popular way to change rates is to use the dual-rate (DR) function. Developed, as far as I know, for pattern fliers years ago, it was the first rate-changing function. DR lets you desensitize the controls, for appropriate maneuvers, with the flip of a switch. DR is still a favorite with a lot of expert and sport fliers, and, once set up properly, it works well. Both high and low rates are linear (see Figure 1).

Note that I said "set up properly." It's not difficult to set up, and it's essential to use the DR to fully enjoy the flight-performance benefits your radio offers.

First, decide whether you really need to switch between low and high rates at all. Many trainer or easy-flying sport aircraft fly very well without DR. If you are flying this type of airplane, set up your radio so that you fly in the high-rate position. Adjust the mechanical linkages so that the maximum stick movement using high rate results in the appropriate control-surface throw (we will discuss the extent of control-surface throw below). This lets you use the radio's full "band width," i.e., you get greater resolution in terms of the gradations of control-surface throw. In other words, your plane may feel more "solid" in flight just by keeping the usual surface throws the same while using high rate.







OK, now that you've decided you want to try DR, you have to decide what the high-rate setting should be. The first rule: never use more control-surface throw than that which can *just* do the job. If you put in more throw than you will ever really need, and in fact you don't use it, you are wasting "system resolution." Let's say you discover that in order to do spins, you need more elevator than is used for normal flying. With the radio in the high-rate position, add more elevator throw, bit by bit, until your plane begins to spin reliably. This is now your high-rate position.

At this point, you may find that the elevator may be too sensitive for smooth, regular flight. No problem; simply flip the elevator DR switch to low rate and voilà! I have found that a good place to start for the low-rate position is about 70 to 75 percent of the high-rate position. It comes down to personal taste—what you feel most comfortable with. The same technique is used for all controls. Follow the above procedure and then "season" to taste.

VARIABLE-TRACE RATIO

Variable trace ratio (VTR) is essentially Dual Rate with a clever twist. To set up VTR, you use the settings that you use for DR, but you must also be concerned with the "knee," i.e., the point at which the rate changes from low to high. VTR is like having your cake and eating it, too, because you can have low rate up to a predetermined stick position and then, at the knee, the radio automatically goes into high rate (see Figure 2).

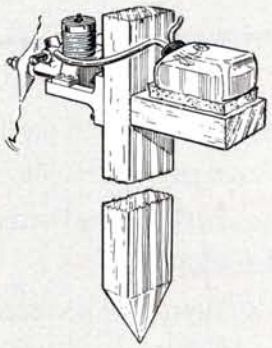
VTR works well because in reality, we generally don't fly with our stick positions around the "knee," but rather around either neutral or nearly full stick deflections. It's not perfect. For example, if there is a large difference between the high setting and low setting, the "knee" angle can be acute, and it can certainly be felt. In fact, I have found that on rudder, we do, in fact, use rudder deflection around the knee, e.g., during 4-point rolls, and sometimes you can see the high rate kick in.

(Continued on page 98)

HINTS & KINKS

JIM NEWMAN

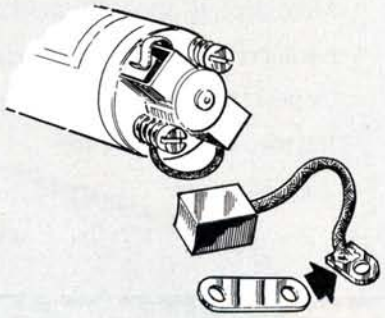
Model Airplane News will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, Ct 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO, AND NOTE YOU SUBMIT. Because of the number of ideas we receive,we can't acknowledge each one, nor can we return unused material.



TIMBER TEST STAND

Made of lumber scraps, this stand can be pounded into the ground well away from the sensitive ears of neighbors. You can build it to the proper size so that it will keep your precious engine above the grit and dust. The sponge-rubber pad under the fuel tank insulates the fuel from vibration and foaming. Make sure that the top is high enough to ensure that you don't pound the cylinder head by mistake!

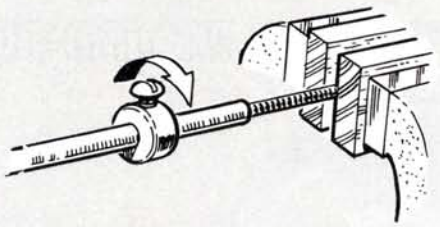
Dan Smith, Seymour, TN



LOW-RESISTANCE TERMINAL

Cut a Gold Bar battery link in half, and solder each half to your motor's brush leads for really low-resistance connections.

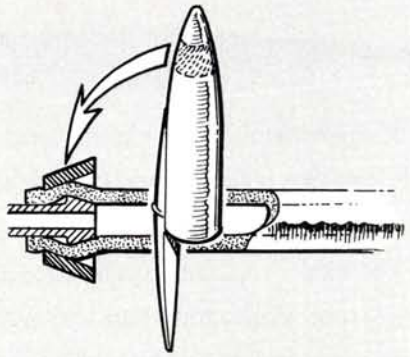
Leo E. Billote, Dededo, Guam



EASY-TURN NYRODS

Grip a threaded stud between wooden blocks in a vise. Lightly clamp a wheel collar onto the inner Nyrod so that you can twist the Nyrod easily onto the threaded stud.

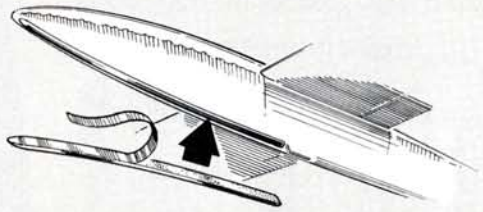
Gilles A. Graton, Montmagny, Quebec, Canada



FUEL-TUBE RETAINER

Cut a suitable ring from a ballpoint pen's plastic cap. Insert the carburetor nipple into the fuel line, then force the tapered ring over the line and against the shoulder of the nipple for a secure, no-leak fitting.

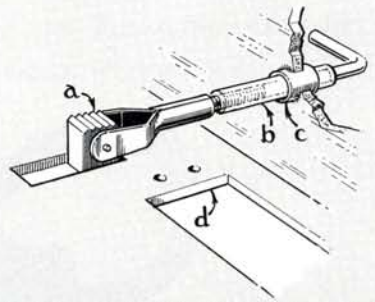
Renato Azevedo, Sao Paulo, Brazil



HARD-WEARING GLIDER SKID

Buy a roll of self-adhesive body side-trim molding from an auto-parts store. Applied to the bottom of a glider, it forms a hard-wearing, attractive belly skid.

Sonny Palfini, Bayville, NJ



QUICK-DETACH SWITCH ACTUATOR

Drill a hole in the switch knob (a) so that you can attach a steel clevis that has been bent to fit around it. Screw on a threaded stud and an inner Nyrod (b) that fits in an outer Nyrod bushing (c). To remove the complete servo tray and switch (d), just unscrew the threaded rod from the clevis and lift out the tray, leaving the clevis attached to the switch knob.

Jim Ryan, Manhattan, KS

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects", we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1993. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

ALCLAD AT-6

Fred Wolf of Pittsburgh, PA, has done what few have successfully accomplished: he built a model and covered it with aluminum panels and rivets. Fred scratch-built his Texan from Nick Ziroli plans over a period of three years. Powered by a Zenoah G-62 gas engine, it has a 101-inch wingspan and weighs 35 pounds. Fred covered the wings, stab and fuselage with 1/64-inch-thick plywood sheeting, and then he added the numerous aluminum litho-plate panels, which he treated with Drano and water to dissolve the protective coating. In all, 96 templates were used to reproduce the panels, which are attached with 12,262 miniature rivets pressed into place. The canopy also has litho-plate aluminum frames, and the entire model is polished with Du Pont rubbing compound for the ultimate in scale aluminum finishes. Fred also made a spun-aluminum cowl and scratch-built the non-retractable landing gear. With a completely detailed interior and other features too numerous to cover here, his Texan is one of the best we've seen.

COLOR BY KODAK

This Ohio R/C Ultimate bipe done up in Kodak film colors is the work of Alan Davis of Brownsville, KY. The Ultimate is powered by an A&M Sachs 3.2 engine with a B&B smoke system, and a Futaba radio is used for guidance. Alan's niece Whitney assists in the studio wearing her color coordinated outfit. Nice duo!

STEALTH FORCE

Joseph Bleil of Jamestown, NY, scratch-built this sport-scale F-117 Stealth fighter by modifying a Balsa USA Force One plan set. He extended the wing's trailing edges; then he built the "F-117ish" fuselage top to complete the illusion. Although now completely invisible to radar, Joe reports that its flight performance is still similar to that of the original Force One design.

COASTAL ATTACK

Daniel Fulmer of San Francisco, CA, wanted something a little different for slope-soaring so he came up with this menacing Messerschmitt. Daniel scratch-built the ME-109 from his own plans. It has an 87-inch span and 950 square inches of wing area, and it weighs only 8½ pounds. The model has a fiberglass fuselage, and the foam wings are covered with balsa and glass cloth. The camouflage paint scheme was created with automotive spray paints, and all markings were hand-painted. The model is very aerobatic, but it isn't as fast as a typical sloper, because of the large fuselage .

PILOT PROJECTS

WONDERFUL WARTHOG

In Battle Creek, MI, the skies are full of A-10s. John Georgoff, who lives there, decided that he wanted one of his own. Not wanting all the hassle of ducted-fan engines, he built his model with two K&B 3.5cc, high-output, rear-exhaust engines with standard props. Constructed of balsa plywood and foam, the model has a wingspan of 48 inches, and it weighs 5¼ pounds. This plane's outline is very close to exact scale, because John visited a local air base for a close look at the real thing. On the wing, the model is said to look so real that it's scary! Look for a construction article on this plane in an upcoming *Model Airplane News*.

U.S. BORDER PATROL

Al Gordon (left) of El Centro, CA, along with three of the pilots who fly a full-size patrol aircraft, are shown here with Al's modified Goldberg J-3 Cub. The model has been modified to resemble the Super Cub used by the U.S. Border Patrol in El Centro. The craft's new nose, landing gear and tail modifications convert it into a *very* close look-alike of its big sister. Al, who is an assistant chief with the Border Patrol, powered the model with an O.S. .48 4-stroke. Looks as if our borders are well guarded.

SUPER SUPER-SPORTSTER 60

After flying control-line aerobatics for 21 years, Mike Ditrich of Erie, PA, tried R/C and now he loves it. His first model was a Sig Kadet Senior, and after more than 75 successful flights, he built his second model—the Great Planes Supersportster .60 shown here. Powered by an O.S. Max .60 FP engine, the plane has a 61-inch wingspan, and it weighs 6½ pounds. Mike painted it with Sig dope over Sig Coverall, and he included some dry-transfer markings. The cockpit is also completely detailed for a very striking and professional-looking model. Who says dope is dead?!

POWERHOUSE TIMES TWO

Larry Snedeker of Carmel, IN, sent in this photo of his double-size 1938 Old Time Powerhouse. The model has a whopping 168-inch (14-foot) wingspan and a length of 120 inches. The wing chord is 26½ inches, and the total wing area is 4,252 square inches (30.9 square feet). The lifting stab has a span of 60 inches, and it's powered by a Saito 150 4-stroke engine swinging a 20x6 prop. The bare-bones weight of the entire structure is only 26 pounds, 4 ounces, and its all-up weight (including covering, engine and radio) is 31 pounds, 14 ounces. Larry says the model lifts off at one-half to three-quarter throttle and flies well at one-quarter throttle. Larry thanks friends Hank Hilscher, Joe David, Dick La Shure, Jeff Cooksey and Chuck Kolby for their help with this project.

THUNDERBIRD'S WINGS

Foster Edwards of Palm Springs, CA, built this great-looking F-16 from a Bob Violett Models kit. Powered by the BVM/Nelson .91 engine, the model has in-flight mixture control, sequencing doors and flaperons and scale, retractable landing gear. Foster also included air brakes from Glennis Aircraft, and scale wheels and hubs. Jesse Sinohiz painted the aircraft, and it's controlled by a Futaba 1024 PCM radio.

AIR SCOOP

CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

Micro Flight

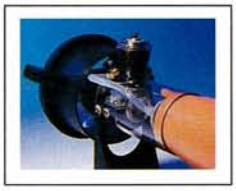
Advances in micro-aviation are stampeding ahead. The G10 CO_2 engine from Gasparin Motors—here mounted in a micro-Taylorcraft held by Otakar Saffek—is one of their largest, with a whopping displacement of 9.82 cubic millimeters and a full system weight of 4 grams. Gasparin's G1—the smallest such motor commercially produced—has a displacement of only .94 cubic millimeters and weighs 1.2 grams with a CO_2 tank, a filling valve and a gas manifold. Order yours from Gasparin CO_2 Motors Inc., Stefan Gasparin, Podskali 96, Ricany u Prahy, Czechoslovakia; 42 (204) 3088; telex: 42 (2) 804135.

The lower photo shows a successor of the Shuriken ½A and (to its right) a high-performance Cox Tee Dee .010

that has been custom-fitted with a tuned pipe by J&M Glasscraft. The 4-inch, 003-inch-brass tuned pipe is mounted on an aluminum-filled epoxy jacket that cloaks the engine up to the cooling fins. With the pipe, rpm jump from 27,000 to nearly 30,000, For more information, contact J&M (Roseville, MI)—(313) 773-7069. For more on the 1/2A, fax Mr. Van Arsdall at (317) 271-6650.

KRESS JETS Mini-Morley

The Morley ducted fan is, according to the distributor, **Kress Jets Inc.**, the smallest production unit currently available. It is a well-balanced, dual-mode device for either electric or Cox Tee Dee .09 power. The optional fan conversion for the TD .09 (shown here) weighs 7.1 ounces (without fuel) and features a simple motor/fuel-tank mounting system. With 25 percent nitro, the unit turns up at 22,000rpm (.28b.hp) and produces 18.4 ounces of thrust. The electric version weighs 8.2 ounces (using the Kress Jets KR-1 motor) and produces 16 ounces of thrust on 10 cells. Retail price of the basic electric version is $42.95. The retail price of the glow conversion kit will be $17.50. For more information, contact **Kress Jets Inc.,** 4308 Ulster Landing Rd., Saugerties, NY 12477; (914) 336-8149; fax: (914) 336-5975.



Rotormax™

These new, carbon-fiber-reinforced, composite blades are from Yellow Aircraft. The ultra-high-performance Rotormax™ fiberglass composite blade is made with reinforced carbon-fiber that's cured with a high-tech process which resists twisting and in flight distortion. The blades' leading edges are all weighted with lead for best CG location. They come balanced and ready to be bolted on. For more information on Rotormax™ blades, contact Yellow Aircraft, 203 Massachusetts Ave., Lexington, MA 02173; (617) 674-2222; fax (617) 674-2188.

Custom Packs from PTI West

So, you're an electric-flight nut who's into power lifting at the Astro Champs, or pylon racing or F3E, and you wonder where you can order custom-matched Sanyo packs like the ones the top R/C car racers use? Call Progressive Technologies West, which has made its name by supplying top-rated batteries to the R/C car market. PTI West offers custom-configured, standard and Super Gold matched packs that use 1400mAh SCR or 1700 SCRC cells. For price information, contact PTI West (Bakersfield, CA); (805) 393-8995; fax (805) 393-8972.

Classic of Classics

Here's a look at the stunning 126-inch-span DC-3 designed by Andreas Gietz of Fiber Classics in Germany. "Sentimental Journeys," which made its debut at this year's Top Gun event, winning "Best Civilian Model," which was awarded by Lanier RC. Controlled by the quick fingers of Stephan Dürrstein of Mühlheim/Main, Germany, the model performed many super, scale-like take-offs and landing while the two O.S. 70 4-stroke engines purred realistically. It's nearly ready to fly, has hinged surfaces, features fiberglass construction (with silver gelcoat) and a fully detailed surface (including rivets and panel lines). Scale retracts are included in the kit. For more information on this classic of classics, contact Model Aviation Technology, 12848 Touchstone Pl., Palm Beach Gardens, FL 33418; (407) 626-66955; fax (407) 626-1588.

Prey on the Competition

According to Robart Mfg., the new technology found in Snake Oil Lubricants will help you to deliver a deadly strike to the competition by increasing your glow engine's life and power. This new line of lubricants and metal treatments that contain advanced petrochemicals and SP-10 which reduces friction and minimizes the destructive effects of electro-catalytic corrosion. There are many products in the line, including Power Rev treatments for R/C engines and fuels. Watch for Snake Oil updates in the pages of *Model Airplane News*.

$kimmer

The low cost of flyin' high

Very few of us "Sunday fliers" consistently catch thermals. Hobby Lobby claims their new Skimmer is designed to do one thing and one thing only— get high enough to reach where *all* the air is rising! The Skimmer is reported to climb to very high altitudes (several times on a single charge!), and it does this with very inexpensive equipment, thanks to extensive R&D overseen by longtime modeler and owner of Hobby Lobby Intl., Jim Martin. The Skimmer kit can be purchased for only $48, and its drive system (prop and motor) costs only $33! Hobby Lobby boasts that the $48 Skimmer truly flies like a $300 custom electric sailplane, and says that the biggest worry of Skimmer owners will be getting the model down out of the thermal! For more information on the Skimmer, contact Hobby Lobby Intl. Inc., 5614 Franklin Pike Cir., Brentwood, TN, 37027; (615) 373-1444.

Race-Ready Unlimited

Instant giants from the sky; something that leaves you time to fly? The Thunder Dragon line of unlimited race-legal ARFs from Sky Aviation includes the Stiletto and P51-D shown here, as well as an AT-6. They may not be as quick to build as an Ugly Stick ARF, but the time savings are said, nonetheless, to be considerable. Call Alan Stanford of Sky Aviation if you want to know more: (514) 449-0142.

mini Mover

This cute miniature air cylinder from Century Jet Models is ¼ inch in diameter and come in 1-inch, 1½-inch and 2-inch strokes. They'll get the job done if your model needs pneumatically controlled, scale operating gear doors, canopies and nearly anything else that moves. The output shaft has 2-56 threads, and the price (from $9.95 to 11.95) seems equally diminutive. Contact Century Jet (Louisville, KY) at (502) 491-4114; fax (502) 245-6675.

Long-Lasting FUN

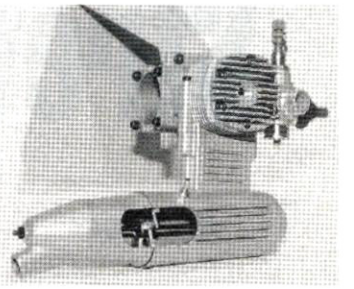
Here's a plane that takes a bouncing and keeps on looping. Duracraft's new fun-fly design features an injection-molded foam wing with an embedded aluminum spar and a one-piece engine mount/landing-gear unit. Five servos (mounted in pre-molded cutouts), and a standard 4-channel radio (aileron servos are on a Y-harness) control the ship. With a .40 to .46 2-stroke pulling this bird, you can make quite an impression at the field for an entire season of sport fun-fly contests. For more information, call Jeff Prince, official Duracraft fun-fly stunter, at (313) 547-5082.

In Flight Rotor Reader

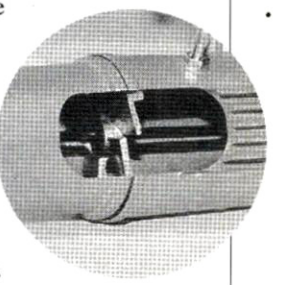
Altech Marketing will soon introduce one of the most useful accessories serious heli pilots can buy—the Silverline Digital Rev Counter from Hirobo. The solid-state, rotor-head speed counter features an electronic shutter that's impervious to wear and consistently accurate. Just flip on the on/off switch and move the thumb-wheel while you peer though the viewfinder. When the main rotor seems to be standing still, take the reading shown on the LCD display. It's like operating a simple camera. A quick-adjustment button allows you to jump through the device's wide rpm measurement range. It's good for two- and three-blade main-rotor machines, and it takes measurements from 512 to 2,559rpm. Dimensions—2.36x4.33x1.29 inches. Contact Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.

Clean Machine

Keep your toasters and tuned pipes sparkling! Few solvents will remove baked-on oil residue, whether it's on rotisseries or rotary-intake glow engines. Seriously, Sunbeam's Metal Klean did a good job, but it hasn't been available for years. Now, Z-Best engine cleaner takes over where Sunbeam left off, and it works just as well, I'm told. Price is $6.95 for a 4-ounce can—enough to clean a couple of dozen grungy glow motors...or toasters. It's made by Airborne Hobby Products, 3764 30th St., San Diego, CA., 92104.



Sound Research



Here's a close look at some muffler R&D that has been going on at the Magnum factory recently. This "fixed-fan" unit sets the gases swirling, and that, in turn, damps the "resonant cracking" that occurs with typical, uninterrupted, expansion-chamber-type mufflers. So far, tests are going very well, and the new muffler may be standard equipment on some Magnum engines in the near future. Stay tuned for further updates.

Lightning on the Slopes

Here's Bob Reynolds of K&BR Model Products (photo taken by Kim Reynolds) with the first of their Baby Warbird Series—the P-38 Baby-Lightning slope soarer. The P-38 has wingerons outboard of the booms and a stabilator for pitch control. The P-38 will be followed by a P-51 and a venerable Grumman F7F Tigercat—all using receivers of a standard size. All the planes in the series will have wingspans of approximately 38 inches and will weigh between 10 and 12 ounces. The Baby-Lightning's testing is complete, and kits are now available for $34. For more information and to order, contact K & BR Model Products, 6155 Graywood Ave., Lakewood, CA 90712; (310) 866-2104. K&BR Model Products also sponsors the Slope-Tech BBS on-line bulletin board; access it with your PC: (310) 866-0924.

Meeting of Great Modeling Minds

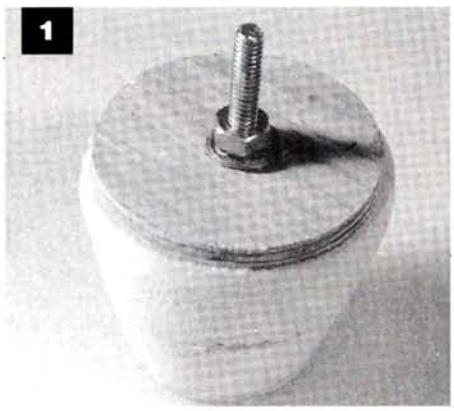
Pictured here are Robart Mfg. president and owner, Bob Walker (left), and Midwest's designer, Tom Herr, collaborating on the retracts that Robart will soon manufacture especially for the new Midwest AT-6. The new Midwest Texan promises to be an extremely popular kit, and with these two great modeling minds cooperating on retract design, Texan owners will have easy-to-install, dependable retracts at their disposal. Watch the pages of "Scoop" for updates on these units.

HOW TO

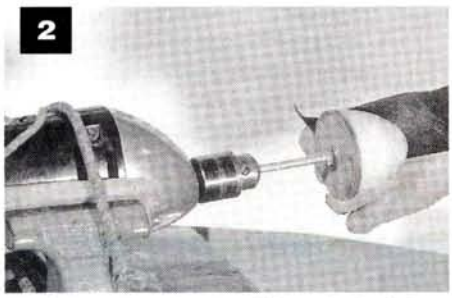
Stretch-Form Plastics

A simple way to make light model parts

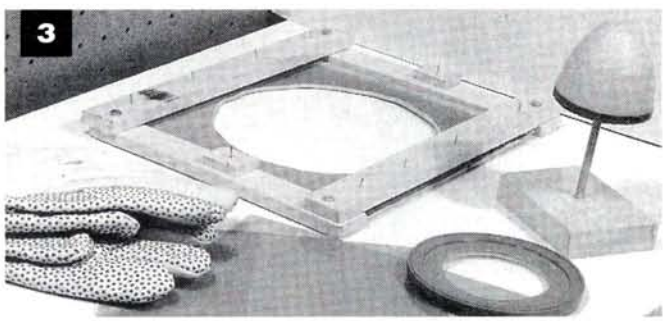
by ROY DAY



Blue foam is only one of several materials that can be used as a mold when stretch-forming plastic parts. To make a mold for a spinner, first glue a block of blue foam to a plywood disk that has a ¼-inch bolt in the center. Roughly shape the blue foam with a saw and sandpaper.



Final-shape the spinner mold by spinning it in an electric drill that's clamped in a vise.



Stretch-forming doesn't require any special equipment. You need: a mold; a simple frame to hold the plastic sheet; a pair of gloves to protect your hands while you heat the plastic; suitable plastic sheet; and, sometimes, a female form (a plastic ring cut out of a coffee-can lid) to help you press the stretched plastic down over the mold.

COWLS, WHEEL PANTS, canopies, spinners, etc., can easily be stretch-formed out of several types of plastic. These parts are generally not available commercially, and they're particularly useful for small models where lightness is a major consideration. Original designers and scale-model scratch-builders often need such parts. This article tells you how to make them.

VACUUM-FORMING VS. STRETCH-FORMING

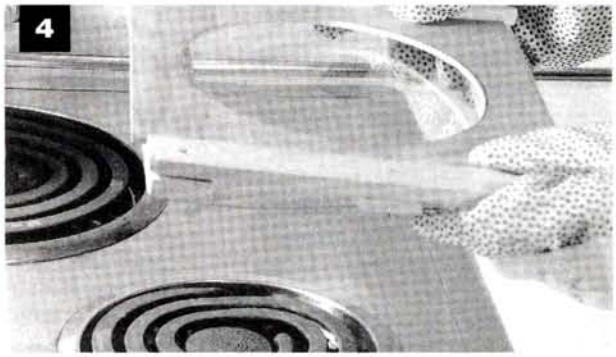
Vacuum-forming is now widely accepted, but stretch-forming is easier and it doesn't require any special equipment. In vacuum-forming, a plastic sheet is held in a frame and heated (usually in an oven) until it softens. Then the frame and the plastic are quickly removed from the oven and placed over a mold that rests on a box that has holes in its top.

A vacuum hose is attached to the box, and the plastic is then sucked down around the mold. A household vacuum cleaner can be used if the plastic isn't too thick or the mold isn't too deep. For applications that require "more vacuum" than the household cleaner can supply, various multi-stage vacuum schemes are necessary.

Contrast this procedure with stretch-forming. All that's required is a way to grip the plastic sheet, an electric-stove burner and a mold of the part.

STRETCH-FORMING

To illustrate the procedure, I'll show how to make four parts: a spinner and a cowl for a scale, electric airplane, and a cowl and a servo fairing for a .40 gas model.



Heat the plastic over your kitchen stove burner until it softens and sags. Wear gloves to protect your hands; leather gloves are safer than cotton ones.

Example 1
A spinner for an electric scale model

I needed a light spinner and cowl for a scale electric model. The lightest commercial spinner I could find was too heavy and not the right shape, so I decided to make my own by stretch-forming.

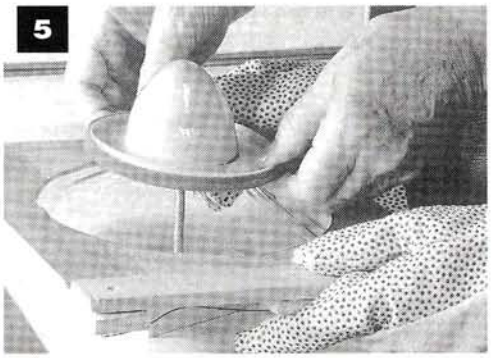
• First, make the mold. You have a choice of materials, including balsa, hardwood, plaster and blue foam. I chose blue foam because it is inexpensive, very easy to shape and adequate for the job. Heat distorts blue foam, so you have to protect it with a layer or two of fiberglass. Blue foam is the type used for building insulation and is generally available in 1-inch- and 2-inch-thick sheets.

Using white glue, foam-compatible CA, or epoxy, glue together blocks of blue foam. For the spinner, I glued the blue foam to a disk of ¼-inch plywood that was the same size as the base of the spinner. The plywood has a

1/4-inch bolt going through the center as shown in photo 1.

Roughly shape the foam with a fine saw and sandpaper, and then mount it in your electric hand drill. Clamp the drill (with some padding) in a vise. Run your drill at a low speed, and use fine sandpaper to shape the foam mold to the shape you want (photo 2). Put a layer of light fiberglass cloth that's saturated with finishing epoxy resin over the mold. When the epoxy is dry, another coat of resin will give a hard, slick finish. The fiberglass cloth and resin will protect the foam from being deformed by the heat. Mount the finished mold on a block of wood using the 1/4-inch bolt as a support.

Next, you need some way to hold the plastic sheet while you heat it and stretch it down over your mold. For a symmetrical part like a spinner, a frame with a circular opening works well. Make the frames out of scrap 1/8- or 1/4-inch-thick plywood. The plastic sheet



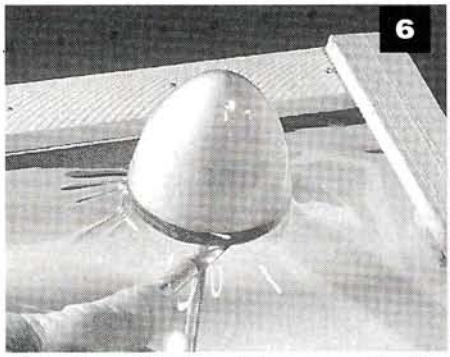
Press the softened plastic over the spinner mold, and have an assistant immediately follow with the female form. (Many applications don't require a female form.)

can be held with small nails, or just clamped between the frames with several C-clamps. For this application, I used 0.030-inch butyrate sheets from K&S.* (There are others you can use; I'll tell you about them later.)

Sometimes, for a "deep forming," a female form is helpful to press the plastic down around the mold. For this spinner, I cut out the center of a plastic coffee-can lid, making it just a little larger than the mold, plus the thickness of the plastic. This is not a critical dimension.

All the materials and the mold, ready for the stretch-forming, are shown in photo 3. Don't forget to *wear a pair of gloves* to avoid burning your hands when you heat the plastic. Although I initially used cotton gloves, leather gloves offer the best protection.

Place the mold on a firm surface close to where you will heat the plastic. Heat the plastic over the stove burner until you see it soften and sag, as shown in photo 4. Then



Using the mold's plywood base as a guide, trim the spinner while the part is still on the mold.

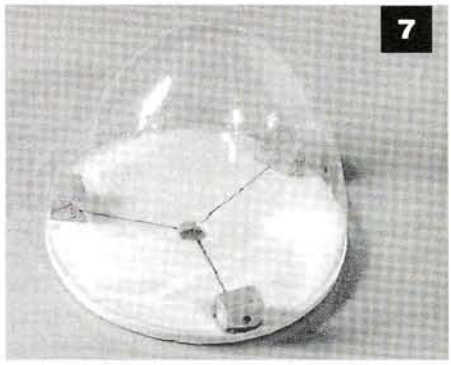
quickly press the plastic down over the mold until the frame is below the bottom of it. If you also use a female form (the plastic coffee-can lid with the hole in it), an assistant must press it down immediately after you've stretched the plastic over the mold, while the plastic is still soft (photo 5).

Hold the frame in place for 10 to 20 seconds until the plastic has cooled. The plastic is thinned by stretching. The final thickness of the formed part may be only one-third to a half the plastic's original thickness. If the formed part is too thin, you'll have to start with a thicker gauge of plastic, or perhaps avoid stretching it quite as vigorously.

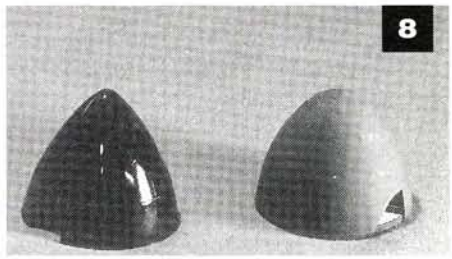
It may take a few tries to get exactly what you want. Remember that if you mess up the part, you can reheat the plastic, and it will more or less return to its original flat shape. Of course, if you have already stretched it too thin, it's wasted.

Trim the part with your X-Acto knife while it's still on the mold (photo 6). The bottom edge of the mold serves as a good guideline. I made a backplate out of 1/8-inch lite-ply and glued three mounting blocks of 1/4-inch-square hardwood at 120-degree spacing (photo 7). The plastic spinner is attached to the backplate with small screws in the blocks.

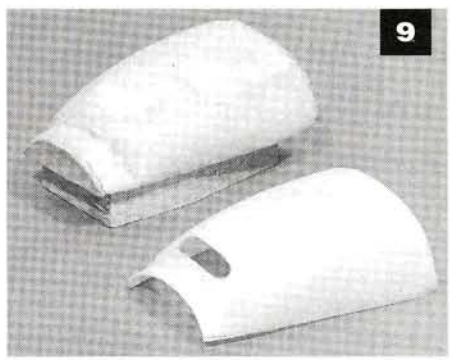
The commercial spinner that's most like the one I made is available from Hobby Lobby*. Photo 8 shows the painted stretch-formed spinner next to the Hobby Lobby one. At about 1/3 ounce, the spinner I made weighs less than half the weight of the commercial spinner, and it closely matches the scale shape I want. For small-scale models, this is important, particularly for multi-engine ones. The process is very simple and can be adapted to a wide range of parts, e.g., canopies, gun turrets and other transparent parts. It takes about as long to explain how to make something by stretch-forming as it does to actually do it!



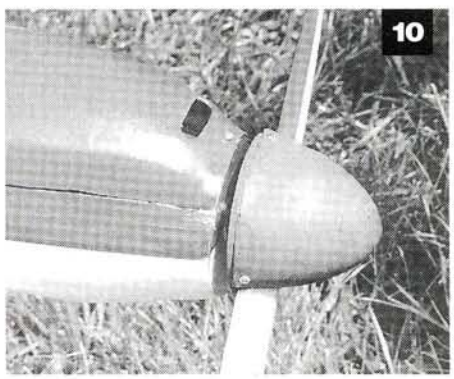
Make a backplate out of 1/8-inch lite-ply, and use small screws to fasten the plastic spinner to hardwood blocks.



The finished spinner on the right weighs less than half the weight of the commercially made one and is the correct scale shape. The spinner was formed out of 0.030-inch butyrate sheet.



A chin cowl was made in the same way, but with a different plastic: high-impact polystyrene. Here's the blue-foam mold and the finished chin cowl. This type of plastic is particularly suitable for high-temperature applications such as a cowl on a gas-engine model. (See the main article for a discussion of several other plastics that can be stretch-formed.)



The finished spinner and chin cowl are shown mounted on a scale electric model. Stretch-forming is easy and allows modelers to design and make their own parts, which are often much lighter than commercial ones.

Example 2
A cowl for an electric

I used the same technique to form a chin cowl, but in this case, I used a different plastic: high-impact polystyrene. This is generally white, so it's not useful for transparent parts, but it's easy to form, tough, and resistant to cracking. It can be cut with scissors, a saw or an X-Acto knife. A Dremel tool also works well for shaping. Suppliers sell it in 2x5-foot sheets in thicknesses of 0.030 inch to ⅛ inch. It costs about 75 cents per square foot for the 0.030- and 0.060-inch thicknesses—the most useful thicknesses for model work.

Photo 9 shows the blue-foam mold and a finished chin cowl. Again, I used blue foam finished with fiberglass. The mold could also have been made of balsa or another wood. If wood is used, you can get away without using the fiberglass.

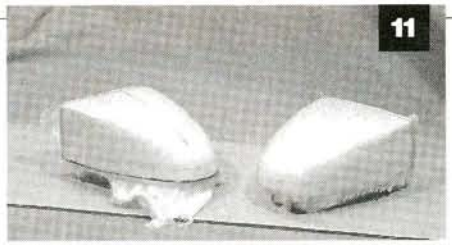
Incidentally, if you want to glue two plastic parts together, lightly sand the parts to be glued, and use your favorite CA. I formed the chin cowl out of 0.030-inch-thick high-impact polystyrene, which was easy to form. Both the butyrate spinner and the polystyrene cowl accepted paint after being scuffed with 400-grit sandpaper. In photo 10, the finished spinner and cowl are shown on an electric scale model.

Example 3
Gas-engine cowl

Again, I used blue foam for the mold. The mold was shaped to the contour of the model's nose, but it's slightly wider to fit over the firewall. Then, the mold was sawn in half along the center line, faced on all flat sides with ⅛-inch balsa and mounted on a piece of scrap 1-inch pine. The pine mounting block has a ½-inch-diameter hole so that the mold can be mounted on a dowel support for the stretch-forming.

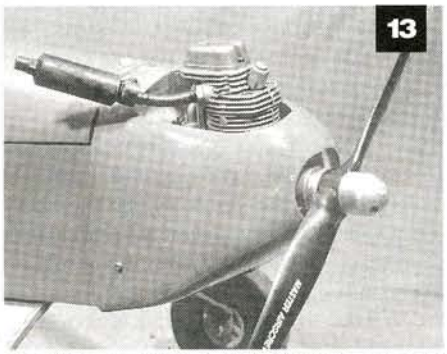
For this application, I tried both 0.040-inch and 0.060-inch-thick high-impact-polystyrene plastic sheet. At these thicknesses, the plastic holds a lot more heat. If you use foam for your mold, it needs more protection from the heat. Excessive heat will cause the foam to soften and be deformed. Put two layers of 3-ounce-per-square-yard fiberglass cloth on all foam molds if you plan to stretch-form material thicker than .030 inch (photo 11). I also painted the molds with white polyurethane enamel to reflect the heat, but this might be overkill.

The half-cowl mold is fairly deep and requires considerable stretching over the nose area before the remainder is stretched and wrapped around the base. For this asymmetrical shape where an end will be open, the best holder for the plastic is a horseshoe shape

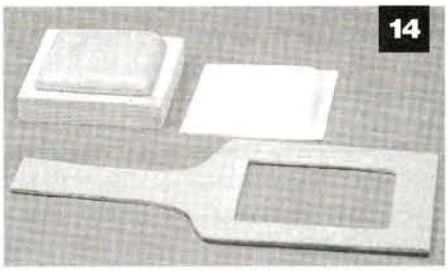


The foam mold for a gas-engine cowl is sawn in two and finished with two layers of fiberglass, so it won't be deformed by the hot plastic.

To stretch-form one half of the cowl, mount the mold on a dowel stand and clamp the plastic sheet in a plywood frame. Note the horseshoe-shape frame that's hinged at the center to make it easier to stretch the plastic around the nose and then down over the sides. The plastic cowl halves can be joined with CA. Remember to wear gloves!



The finished cowl on a sport .40 plane. Use your Dremel tool to make the engine cutouts, and paint the cowl with any good fuelproof paint.



This balsa mold was used to stretch-form a simple fairing. The open female form was used to press the heated plastic down firmly and produce a flange that allows the fairing to be attached to the wing.

that's hinged at the middle of the "U," as shown in photo 12. The "U" part allows you to stretch the plastic over the nose piece, and then you can fold down the side pieces as you stretch the top and bottom of the cowl. A little practice, and you'll get the hang of it. By using C-clamps, the same "frame" can be used for jobs of different sizes.

When the halves of the cowl have been formed and trimmed, they can be joined using either CA or fiberglass. Applications of fiberglass cloth with thin CA can be used to reinforce certain areas, particularly areas around cutouts and attachment points. Use your Dremel tool to make the cutouts for your engine. Any good, fuelproof paint can be applied after a light sanding. The finished cowl is shown on a sport model in photo 13.

Example 4
A servo fairing

I needed a shallow fairing of light plastic to cover a servo installed in a foam wing. For this, I made the mold of balsa, which I mounted on a pine block in such a way that it had a ¼-inch flange on all four sides for mounting. To press the soft plastic down firmly to form the flange, I made a female form of ⅛-inch scrap plywood with an opening about ⅛ inch bigger than the mold. The part was easily formed of 0.030-inch high-impact polystyrene. Butyrate would have worked just as well. Photo 14 shows the finished fairing along with the balsa mold and the female pressure form.

OTHER USEFUL PLASTICS

As well as butyrate and high-impact polystyrene, several other plastics can be used.

• **ABS** is similar to the polystyrene and is easy to form. For clear applications, there are two others: PET-G (trade name, "Vivak") and polycarbonate. Vivak is easy to form, but it's a low-temperature plastic that isn't suitable for a cowl that's near a hot gas engine.

• **Polycarbonate** withstands high temperatures, but it's more difficult to form. It's virtually indestructible and is good for large-scale projects. It also costs twice as much as any of the other plastics mentioned.

All these plastics are available from plastics suppliers in sheets of various thicknesses. Sometimes, you can buy them from makers of outdoor signs. You might get samples from their scrap boxes.

SUMMARY

Stretch-forming has a lot of applications in modeling. It's simple and requires no special equipment. Experiment with various types of plastic. You'll enjoy making parts you've designed to complement your next modeling project.

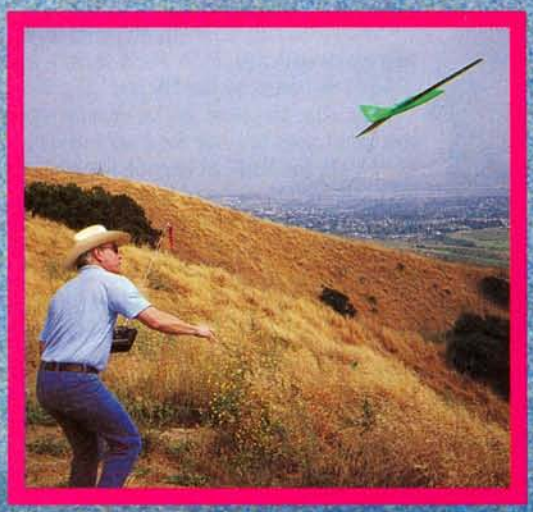
For a complete description of vacuum-forming techniques, including the equipment and types of plastic, I recommend, "Vacuum Forming," by Douglas Walsh, P.O. Box 214318, Auburn Hills, MI 48321.

**Here are the addresses of the companies mentioned in this article:*
***K&S Engineering,** 6917 W. 59th St., Chicago, IL 60638*
***Hobby Lobby Int'l. Inc.,** 5614 Franklin Pike Cir., Brentwood, TN 37027.* ■

"HEY, LOOKS really wild! But don't those things need computer control to be stable?" I hear this a lot whenever I take the Toucan out to fly. The idea that forward sweep is inherently unstable comes from the X-29 experimental fighter which is, indeed, unstable in pitch and really does need computer control to survive. The truth of the matter is that they designed it that way on purpose in order to maximize maneuverability. The designers simply moved the center of gravity (CG) so far aft that the full-scale aircraft wants to diverge from a smooth flight path and must be held there by a computer giving constant control inputs.

There has been at least one ducted-fan model of the X-29 successfully flown with conventional control; the modeler properly balanced it to be stable. A number of conventional soaring gliders are flown in unstable condition, and as a result will "tuck under" in a dive. The instability is very slight, and the human brain is easily quick enough to compensate, but I digress.... The bottom line is that Toucan is stable and requires no heroic measures for control.

So, why go for the sweep forward? Partly to have something unique to fly, but mostly to experiment with the concept and check out the reputed advantages. Forward sweep provides the same drag reduction as aft sweep on wings in the transonic flight regime. Though I didn't really expect a slope glider to check out that claim, some of the "lead sleds" at my local slope sites certainly look like they are approaching the sonic region.

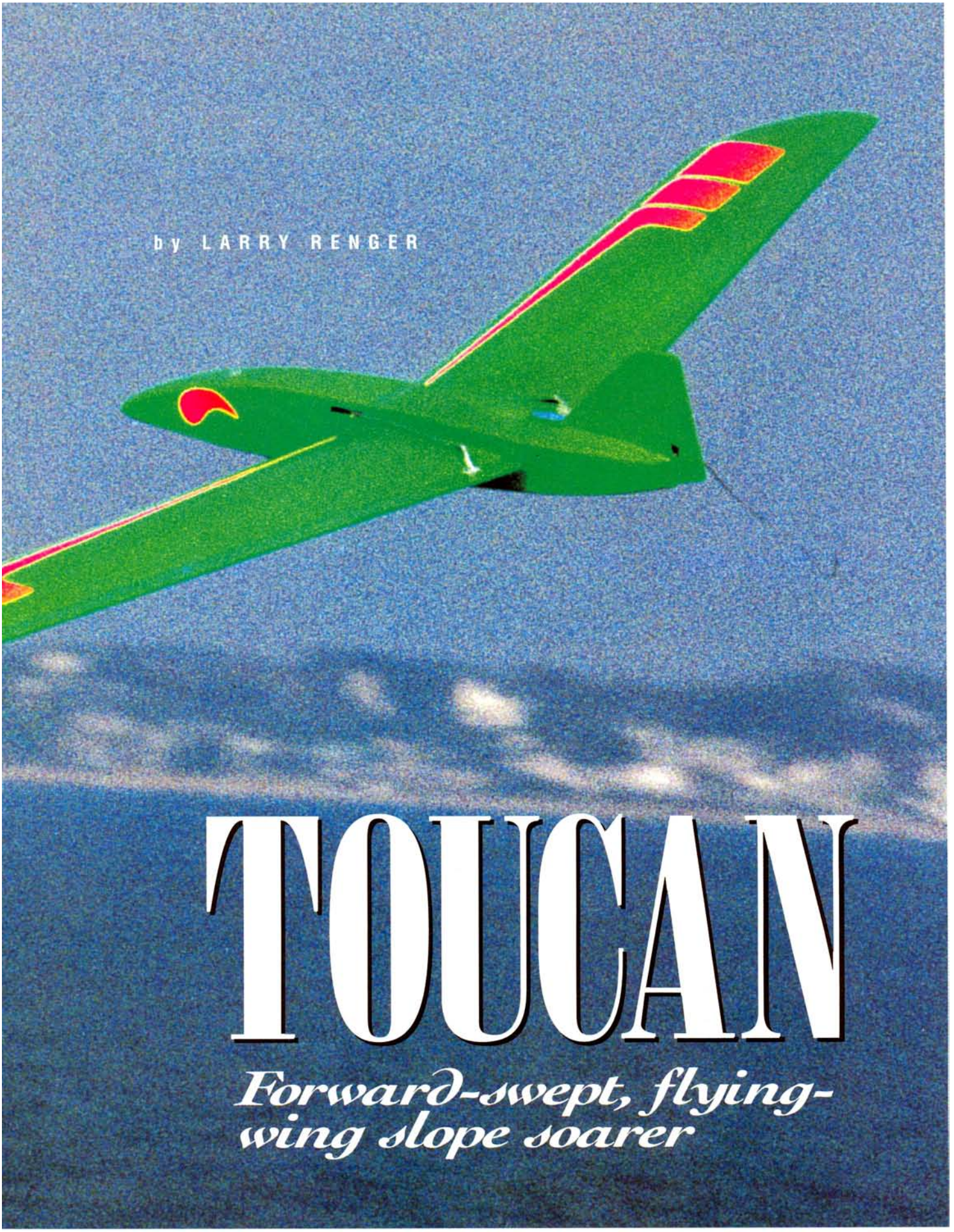


Above: the author launches the Toucan from a slope-soaring site on the California coast. Center spread: A Toucan built by Editor-in-Chief Tom Atwood is captured in flight at Cape Cod, MA. Tom reports that the craft was easy to build and exhibited docile flight characteristics in gentle winds, with no tip-stalling. This ship weighs 18.5 ounces (with Cannon micro receiver and three servos) and utilizes external elevon linkages. Wing markings and eyes are from Dumas/Eagle R/C Graphics*. Compare static shot shown later in this article to see the extent of streamlining the design permits. The optional rudder had not yet been tested in high-speed winds. (Will adverse roll result from the forward-swept wings?) Photo by Tom Atwood; Michael Lachowski, pilot.

SPECIFICATIONS
Wingspan: 42 in.
Wing area: 278 sq. in.
Weight: 16 to 24 oz.

THE MODEL

Toucan has demonstrated the good forward-sweep advantages noted in the sidebar. At speed, it will turn remarkably fast due to the high lift it can generate without snap-rolling. When you crank in the up trim slowly, it just slows down and slows down. It does not, of course, turn into a "floater" in the mush mode; it is too heavy for that. In a zoom stall, it breaks clean and resumes flying very easily.



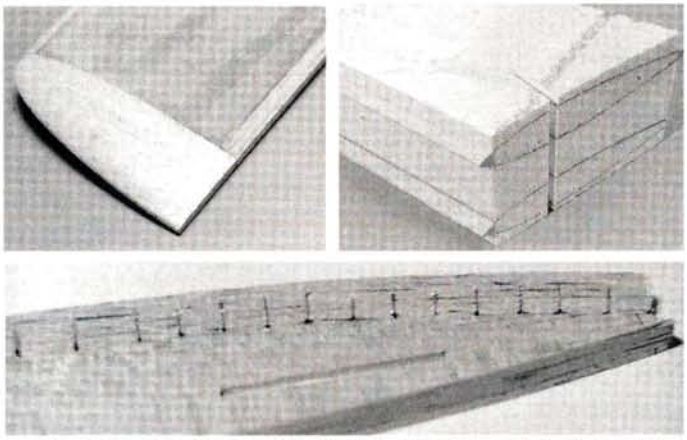
by LARRY RENGER

TOUCAN

Forward-swept, flying-wing slope soarer

The best-flying of the Toucans built so far had the ailerons and elevators separated as shown on the plans. The ailerons were set up without any reflex (upswept trailing edge) and the stability was entirely generated by reflex on the elevator section. The drag was noticeably reduced compared to equal reflex everywhere as seen on the elevon versions.

I am going to try putting some twist in my elevon version to add reflex in the center and reduce it at the tips to simulate this effect.



1.Top Left: smoothly rounded wingtips of balsa could also be Rohacell foam. Elevons extend all the way out to the wing's end. 2. Top right: completely covered and sanded wings are reassembled in the nests with double-sided tape, then band-saw-cut to root and spar dimensions. 3. Bottom: kerf cuts in the triangle stock allow smooth curves to be formed without excessive stress on the parts.

One thing for sure about the Toucan; it certainly gets you a lot of attention at the slope! In addition, Toucan is a really good flying model, and it will perform competitively with other models that have similar wing-loading and airfoil. Rolls are quick, straight and true, loops are clean and fast, and landing is easier than most due to the resistance to tip stalls. The model has the unusual ability to slow down without the need for spoilers or flaps. Mind you, Toucan still will not match a similar-size conventional model for maximum lift to drag performance, but it is closer than any plank or swept-back wing I have flown. No one who has seen the model fly has criticized its performance.

Oh yeah, the name. When I designed Toucan, it was going to be called the Katana (long Japanese samurai sword). When I built it, it looked a lot more like that big-billed bird on a Froot Loops box, so there you are. Guess I'll have to design another one to be the Katana.

Construction is a bit unusual, but really easy. The only peculiar requirement is that you really need to use a band saw or a jigsaw (even a saber saw might work) to cut the spar notches in the wing. If you don't have one, hound your friends till you find one to borrow. Do not attempt to cut the wing-spar notches in the wing by hand unless you are willing to do a careful job of aligning and filling in the gaps to make sure the wings are absolutely parallel. Airfoil patterns and specifications are provided to cut the wing cores.

4.Drywall sanding screen bonded to wood block is the best for sanding foam surfaces. It can also be bonded to soft foam for sanding contours on balsa.

BUILDING

Start with the wing. If you want to lay out your patterns from scratch, the airfoil is a NACA 63_2-015, with 7.75-inch root and 5-inch tip chords (due to the sweep, the thickness is 12 percent). I now use Tekoa's* Feather-Cut machine to cut my foam cores, and Aerospace Composites* system to vacuum-bag the sheeting. The patterns are done on CAD and printed by laser. You can't get much more accurate than that. I highly recommend machine cutting and vacuum-bagging; they make wing building easier, better, and will give you a more accurate surface with a better finish. However, the original Toucan wings were hand-cut, and

5.Left: spar and wings have been epoxied together. Spar shown was balsa and was too weak. Use ply or spruce. 6.Right: bulkhead is glued to spar and wing roots. This provides primary alignment for the entire fuselage.

Why Forward Sweep?

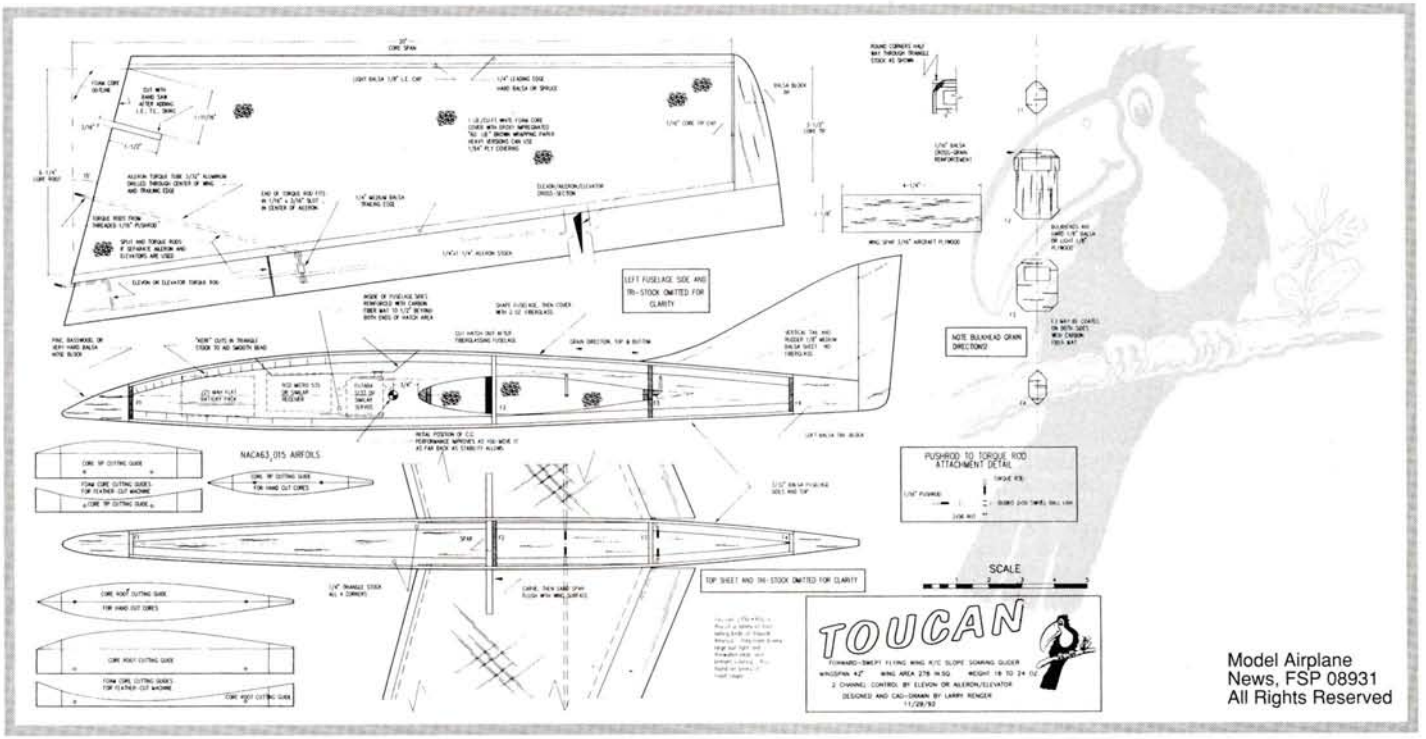
Forward sweep does have a real advantage in our speed range. Sweeping a wing causes a certain amount of spanwise flow toward the aft portion of the wing. This is due to the changing position of the negative pressure spike near the upper surface leading edge of any airfoil section. This flow carries along an increasingly "dirty" boundary layer and initiates early stall in the rearmost part of the wing panel.

In the case of rearward sweep, this means that the flow is toward the wingtips. This causes the wingtips to stall first, before the center of the wing stalls. Since one tip stalls before the other, the aft-swept model is prone to spins. This is aggravated by the fact that the elevons are usually out at the tips and effectively set the tips to slightly different angles of attack. In a flying wing, you wash out the wingtips to get stability. Though that often does alleviate the tip-stall problem, performance is always less than a conventional aircraft, despite what flying-wing aficionados claim.

When, however, you sweep the wings forward, those self-same pressure forces drive the flow from the tips to the center. The tips stall after the wing center section, and the model will drop its nose straight and true. In a forward-swept flying wing, you wash out the center section to achieve higher angles of attack, so the center doesn't really stall either! What happens is a condition similar to a conventional free-flight model in dethermalizer mode: the model picks up lots of drag, and just starts to mush into a steeper and steeper, but stable descent. Push in some down, and you fly right out of it again.

There are two types of stalls; the ones where you have trimmed the model to fly too slowly, as above, and the ones you "zoom" into, and the model stalls due to a loss of airspeed in the climb. Excessive forward sweep is reputed to cause the possibility of hammerhead stall characteristics in a zoom stall. In this case, you'd see a drastic pitch up and even a flip over the top when the model is finally pushed too far. Toucan has only a moderately swept wing, so the pitch characteristics are much like a conventional model; no hammerhead stalls have been seen.

Forward sweep does not do anything to improve L/D (lift to drag ratio); it only improves the stall characteristics.



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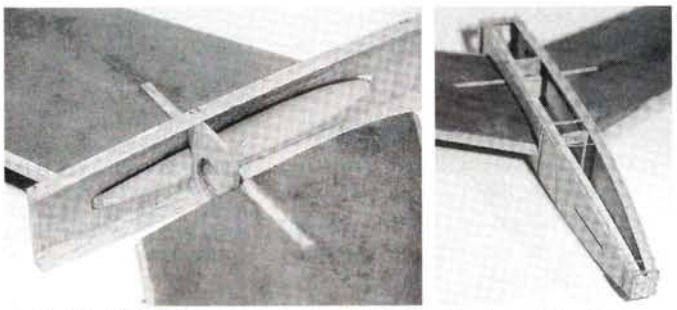
sheeted using bricks for weight and wax paper for separations, so it is possible to build without the "good" stuff.

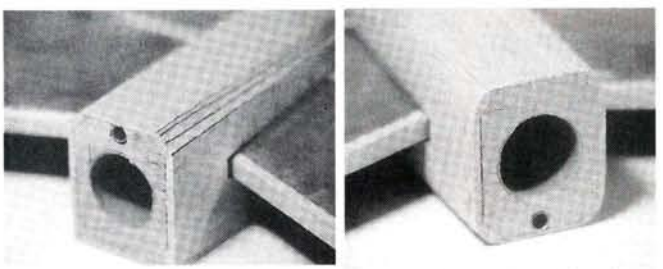
WING CORES

After cutting your cores, you need to do some sanding and other preparation. Make a sanding block out of a 12x2x1-inch block of wood. Use carpet tape (heavy double-sided adhesive tape) to bond fine-grit 3M drywall sanding screen on (see photo 4). This stuff will cut foam while providing a place for the shreds to go without gouging the surface. Blow off the block and wipe the wing surface frequently to prevent build-up of foam shreds. Use the nests to support the wing cores as you sand. Handle them very gently at all times to avoid fingertip-size dents in the surface, and be careful not to round any of the edges. Fill any gouges with lightweight filler such as Model Magic*. Basically, sand down the bumps and fill in the hollows.



7. Left: different airplane, same construction. Fuselage side slides over wing up against bulkhead. Wing extends about 1/16 inch inside fuselage. 8. Right: use rubber bands to assemble fuselage sides and bulkheads. Double-check the alignment, then glue it all together with a foam-safe CA.

Before you sheet the wing, add the trailing edge, the 1/8-inch leading edge and the 1/16-inch tip caps to prevent the edges from being rolled over. These caps should extend the wing contour without having rounded corners. Cover the wing cores with 1/64-inch-thick aircraft plywood; I used epoxy for the bond, but 3M's 77 spray cement will also work well, and should be lighter. You can use other covering materials to make the model lighter. It can be covered with epoxy-impregnated brown wrapping paper, paper and fiberglass laminate, and just fiberglass; they all work. The paper version was the lightest, and more than strong enough.



9. Left: initial shaping of the fuselage sides. Carve a bevel that shows 1/8 inch of the triangle stock at the widest points. 10. Right: final-sanding produces a smooth contour for good looks and clean airflow over the fuselage.

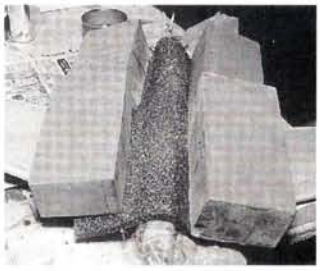
CUTTING THE SPAR NOTCHES

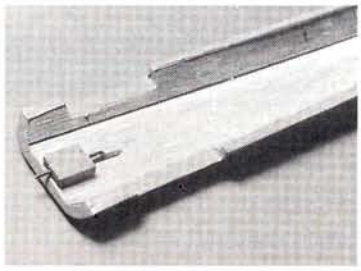
After covering the wings, add the leading edges, trailing edges and tips (photo 1). Shape and sand everything to finished contour. Now comes the one unusual step. Use double-sided tape to replace the wings in their nests as accurately as you can. Take your time and get it right! Use an accurate square to true up your band saw; the usual calibrations on a normal saw are not accurate enough. Saw the wing root angle and spar notch as shown on the plans. The result is shown in photo 2. Phew! That takes care of your wing alignment and assembly setup; building the rest of the model is easy. The wings can be removed from the nests and the nests tossed out now.

Cut out all the remaining parts from the materials specified. Medium balsa is ideal for the fuselage sides, planking and triangle stock. Try to match the balsa as closely as possible from side to side to avoid one side bending more than the other in assembly. Use lightweight C-grain balsa for the vertical tail, and medium-hard for the ailerons. The nose block should be hard and the tail block soft.

The spar on the original Toucan was medium-hard balsa, and although adequate for flight and landing loads, it eventually proved

to be the weak point in crashes. The spar should be aircraft plywood or spruce. For a very lightweight version, consider a laminate of 1/32-inch plywood on each side of 1/8-inch medium balsa. Also be sure to run the grain crosswise on bulkhead F3; it takes a beating when the wingtips hit things.





11. Left: soft foam, a plastic bag, and bricks were used to ensure that the Kevlar bottom covering conformed to the fuselage contour. Same effect as vacuum-bagging. 12. Right: simple hatch latch. Wire slides under lip of fuselage, and friction keeps it there. Haven't lost a hatch yet.

TAPERED FUSELAGE

Stack the two fuselage sides and cut them out together for perfect symmetry. Add the triangle stock to the fuselage sides at this point. Be sure to make right and left sides, or you will have to build a second Toucan to go with the extra part. Use "kerf" cuts in the triangle stock to assist in flexing the wood to match the fuselage upper and lower contours (photo 3). These are cuts made with a razor (Zona or X-Acto) saw, and they go about halfway through the stock from the inside of the curve you are trying to bend. Space the cuts closer where the bend gets tighter.

Pin the fuselage sides down to a flat surface before gluing on the tri-stock, or you may warp in some twist due to the stress of bending the stock. I use cyanoacrylate (CA) glue for assembly of the entire model, but am careful to only use UFO* (foam-compatible) CA near the foam parts.

ASSEMBLY

Assembly is very easy. As shown in the photographs, first epoxy-glue the wings and spar into a single unit (photo 5). Next, slide bulkhead F2 in from the rear. It should fit snugly up against the spar and overlap the wing root by 1/16 inch on each side (photo 6). Glue it in place. Now slide the fuselage sides over the wings and up against the bulkhead (photo 7), slip the other bulkheads in place and rubberband the entire assembly together (photo 8, another airplane design, but the same technique). Make sure that everything is aligned, and especially that the wing halves are true with respect to each other. When all corrections have been made, use UFO or similar foam-safe CA to bond the sides to the wings and bulkheads.

At this point, put in a tube for the antenna to exit the rear of the model. If you are using internal control linkages, install them at this point. For elevator or elevon versions, the smallest linkage I have found is the one shown on the plans. Don't forget that those links swing in and out due to the trailing-edge sweep and need to clear the fuselage sides and each other.

Sheet the top and bottom of the fuselage. True up the ends and add the nose and tail blocks. Shape the fuselage to a pleasing, rounded contour. About 1/16 inch to 1/8 inch of the triangle stock should show on the corners of the fuselage at the widest point (photos 9 and 10). Since you are going to glass-cover the fuselage, it is unlikely that you will get it too thin. Sand the entire model smooth with 180-, then 320- and finally 400-grit paper. I put a layer of lightweight Kevlar cloth on the bottom of the model before doing the glass.

Kevlar is pretty stiff and wouldn't go around the corners, so as shown in Photo 11, I persuaded it with a plastic bag, some urethane foam sheet, and bricks. Same effect as vacuum-bagging! Use 2-ounce (medium) fiberglass to cover the entire fuselage, including right over the Kevlar. I adhere the glass to the fuselage with a light spray of 3M's 77 spray glue *[Editor's note: always wear a respirator when using spray glues.]* and bond it with CA. Not cheap, but simple, easy, and very quick.

Use the razor saw to cut the hatch from the fuselage, make, shape and glue on the vertical tail, and you have a model ready for equipment installation and finishing. A very simple hatch-latch system is shown in Photo 12.

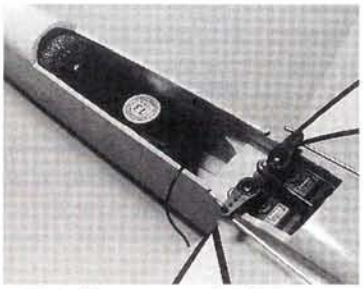
MIXING AND LINKAGE OPTIONS

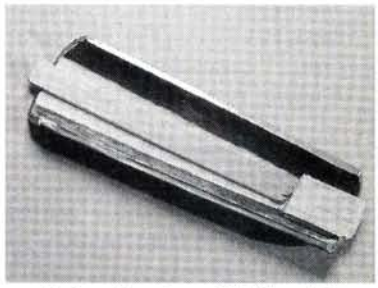
The original model used an electronically mixed control system (photo 13 shows the elevon linkages and servo mounting), but there is room to install a sliding tray or a Du Bro-type mixer. This configuration is the easiest to build.

Other versions have been built since. One has elevons with servos buried in the wings; another has one servo in the fuselage for the elevators with aileron servos buried in the wings. The original was rebuilt with the elevon torque rods and all linkages internal. The plans show how to have entirely internal aileron and elevator control. If you only plan to put servos in the wings, you could slim the fuselage down by about 3/16 inch more!

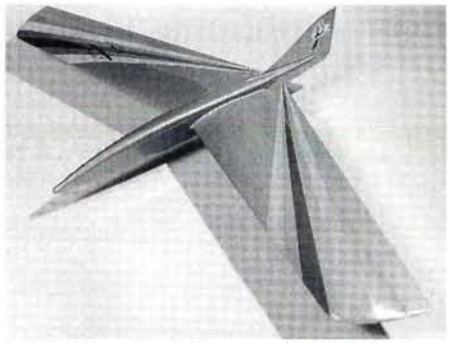
CONTROL THROWS

Set up the control throws so that full aileron deflection kicks the elevons up and down each about 3/16 inch, and full elevator control gives about 3/32 inch each way. My Futaba* Super 7 transmitter is programmed to only provide 40 percent throw on elevator channel, and then the aileron and elevator dual rates are set to 60 percent. This is good for starters and can be modified later to suit your own level of skill or courage.





13. Left: servos mounted in the open space in the wing. Arms stick through fuselage sides to external horns. You could also do internal controls with a bit more effort. 14. Right: the popsicle-stick hatch retainer. Only the forward end is glued down; the rest acts like a spring to allow the hatch to slide back for removal. The balsa block fits under the nose end of the fuselage for retention.



15. The author's Toucan shows extensive streamlining.

Toucan really responds to control input, but is very neutrally stable on its own. That is, it will proceed in a straight line wherever you last aimed it, but will turn *right now* when you give control input. *Important!* Set the elevons only about 1/16 inch above dead neutral for your initial trim in pitch. With a

(Continued on page 98)

SMALL STEPS

RANDY RANDOLPH

SMALL TRAINERS AND FUN-FLY

WHEN STEVE WINNALL of Melbourne, Australia, wanted a trainer that would allow him to learn to fly R/C without benefit of an instructor, he built a 40-inch-span glider, powered it with a Cox .010, and learned.

You would think that a guy who lives in a country with lots of wide open spaces would choose to build big airplanes, but Steve's good taste prevailed. His advanced trainer was a "Onecent" (*Model Airplane News*, August '90); followed by an 11-inch-span, .020-powered "Mighty Midge" bipe; and, finally, a .010-powered "Micro" with a 7¼-inch span. Steve came up in the world by coming down in size!

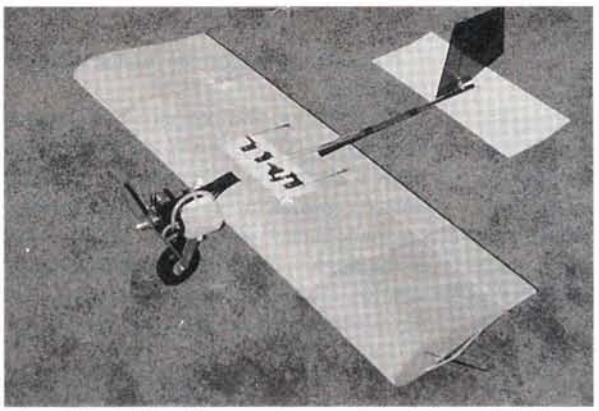
SMALL FUN-FLYER

Over the years, fun-flys have become specialized contests, and if you want to be competitive in these events, a specialized airplane is necessary. Joe Geiger has come up with the idea of a "convertible" fun-fly

Looks like a TD .049-powered, 2-channel airplane. If that was a 6-inch prop, it would still be a little airplane. What if it's a 3-inch prop?

airplane. Remembering his "Tadpole" design (*Model Airplane News*, January '92), you can visualize his latest effort as he describes it:

"It uses an old baffle-piston O.S. .15 for power, and it can out-roll all the competition-type fun-fly planes in this area. It weighs just slightly more than two pounds and is extremely agile. Why do I call it 'convertible'? Well, in just about two minutes, the tail boom slides out, a short tube with a vertical stab slides in, the computer radio is switched to another memory, and the plane becomes a great-performing flying-wing combat model. The change results in just the right amount of CG shift. Also, the conventional tail can be swapped for a vee-tail in the same way."



Joe Geiger's O.S. .15-powered convertible airplane. Its Tadpole ancestry is evident.

DIESELS FOR FUN-FLYING?

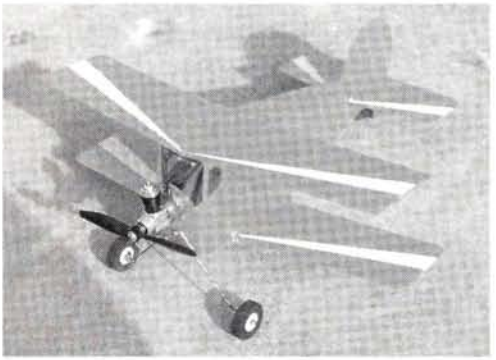
While we're on the subject of fun-fly airplanes, it's a surprise to me that diesel engines have not become very "big" in these events. My .049 (.8cc) P.A.W. diesel will turn an 8x4 prop at more than 8,000rpm, and it's fuel-efficient at the same time. Engines like that should be naturals for lightly loaded designs that are based on agility rather than speed. A real advantage is that they tend to keep the same rpm whether climbing or diving.

True, diesels do require a short get-acquainted period before their operation becomes automatic. The fact that you don't need to feed them starting batteries all the time makes up for any extra time spent learning their tricks. Another thing: since diesels run at lower temperatures than glow engines, the oil in the fuel isn't converted to varnish, so that hard, brown buildup vanishes—along with the need for starting batteries!

Eric Clutton, the Diesel Doctor*, is a good man to talk to about diesels in general and P.A.W. diesels in particular. Not only does Eric import P.A.W. engines, but his "Olde English Mix" fuel also contains an additive that takes away a lot of the kerosene smell that usually dominates diesel fuel. I didn't believe it until I got a batch and tried it out. Sure enough; it does smell better. When you buy that diesel, be sure to get some of Eric's fuel; it does ease the transition from glow to diesel.

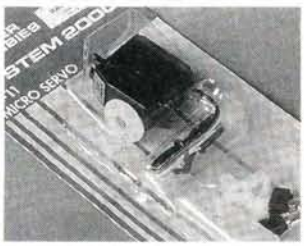
Just for fun, how many of you remember the Drone diesel? If you remember the Drone, you also remember *Air Trails* magazine. There was a year or two just after WW II when that magazine published full-size plans in every issue. Their plans included rubber- and gas-powered scale, both FF and CL, and small, sport, free-flight in both rubber and gas. Quite a few of them would make great projects for small R/C.

A while back, I wondered why there were so few models of the Boeing L-15. Well, there were full-size plans for a CL



Steve Winnall's bipe looks a lot bigger than it really is. Clue: it's single-channel and .02-powered.

TS-11 Servo



When Tower Hobbies* launched the System 2000 line of servos, they thoughtfully included a genuine micro in the series.

Designated the "TS-11," it's slightly smaller than the famous Futaba S-33 and weighs only .61 ounce, which is just .01 ounce heavier than the S-33 and only .06 ounce heavier than the tiny Kyosho KS-31. Speed is .15 second for a 60-degree rotation, with an output torque of 30 ounce-inch. The TS-11 comes with mounting hardware and a selection of output arms. Best of all, it costs less than $25.

version published in *Air Trails* way back in 1947. Bill McClure* has a collection of old *Air Trails* magazines and, one rainy day, he decided to look it up. He couldn't find the L-15 issue, but he did find a number of interesting airplanes. Anyway, he catalogued quite a few issues and would be willing to share his information with anyone who might be interested.

** Here are the addresses that are pertinent to this article:*
***Eric Clutton,** 913 Cedar Ln., Tullahoma, TN 37388; (615) 455-2256.*
***Bill McClure,** Rte. 2, Box 192B, Midville, GA 30441.*
***Tower Hobbies,** P.O. Box 9078, Champaign, IL 61826; (800) 637-4989.* ■

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

Author Ed Ducote with his Thunder Tiger Explorer 2M.

I TAKE ABOUT 4 hours to cook a good pot of gumbo. It takes 4½ hours to drive 20 miles during rush hour on the freeway. It took 4 hours, 28 minutes—from the time I opened the box—to assemble the Explorer 2M sailplane and prepare it for its first hand launch.

Distributed by Global Hobby Distributors* and manufactured by Thunder Tiger, this sailplane should be designated "AIRF" (almost *immediately* ready to fly). Designed for beginners, it's great for intermediate fliers, too. With its generous wing area and modified, flat-bottom Clark-Y airfoil, the Explorer combines slow, stable flight characteristics with exceptional strength—great for novices, who can learn and develop flying skills with confidence.

When it passes overhead, the Explorer's bright pink patches make it more visible.

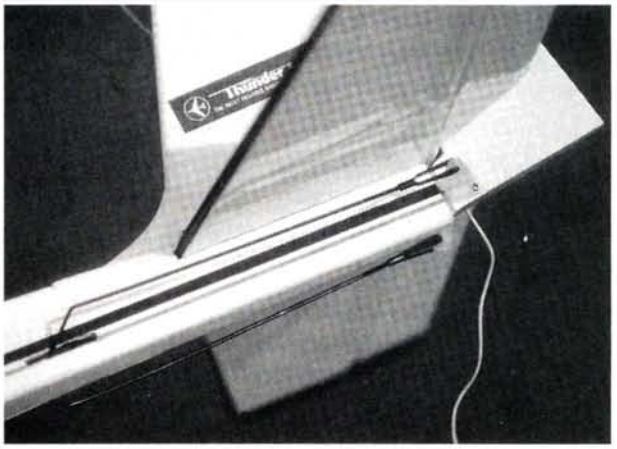
by ED DuCOTE

THUNDER TIGER

Explorer 2M

THE KIT

All the parts and sub-assemblies were there, and everything arrived intact. Construction was sturdy, and the wood was above average. Egads! These guys still like that gosh-awful PVC adhesive film for covering! Not only is it heavy and difficult to shrink adequately, but it also has a nasty habit of coming off. Also, direct sunlight can make it slacken and wrinkle. Enough about the covering. I think you get my drift.



Routing the pushrods was tricky. Bend them before they're finally installed. Note that the elevator control horn is flush with the fuselage bottom.

CONSTRUCTION

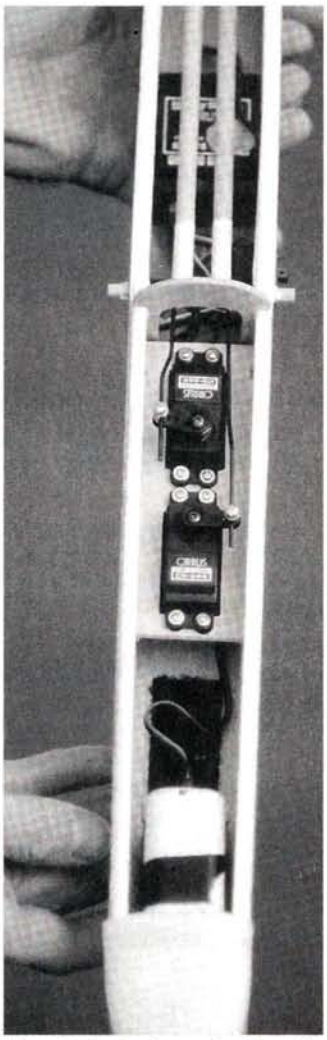
Four hours and 28 minutes after I had started, I was walking to the flying field—no kidding! And I didn't have to race the clock. I took my time and methodically followed the instruction manual and good, basic construction techniques and used 5-minute epoxy throughout.

• **Wing assembly** was straightforward. There are two center panels and two tip panels. Find the six plywood dihedral braces and sort them out—two for the center (these are slightly shallower) and four for the tips. After gluing the halves together, test-fit each completed brace into its home panel. I had to do quite a bit of sanding to get a very snug fit, as the braces in the review kit were slightly oversize. If you plan to winch-launch really hard, make new braces out of 5mm plywood and use them instead of the kit's "lite-ply" braces.

Join the two panels, by holding one panel down on a flat surface and supporting the other until the glue has set. Use the same technique to join all the panels. When the epoxy has set, cover the joints with the supplied colored adhesive strips. Finally, to prevent rubber bands from crushing the trailing edge on the center panel, glue the ABS strip to the top of it.

• **Tail surfaces.** These are completely finished and hinged. The stabilizer is hinged with tape, and the rudder has the nylon/pin type of hinge. After trial-fitting it, glue the stabilizer onto the fuselage. (Remember to remove the covering that's on surfaces to be glued.) While the glue is setting, re-check stabilizer alignment with reference to the wing-mounting platform. Mark the area on top of the stabilizer where the rudder will go. Take the covering off this area, and glue the rudder into place. Make sure that the rudder is perpendicular to the stabilizer.

• **Landing skid.** This is designed to be attached to the fuselage bottom with two screws—no problems here. The nose cone is also attached with two screws that go through the firewall bulkhead. I thought this would be too weak to withstand rough landings, but it's fine.



There's plenty of room for the radio gear. The fuse will accept standard servos. Note the 450mAh battery in the forward compartment.

RADIO GEAR AND CONTROLS

I control my Explorer with the Cirrus* FM 7-channel radio and two standard servos, which fit properly into the plywood platform

SPECIFICATIONS

Model name: Explorer 2M
Type: 2-meter thermal glider
Manufacturer: Thunder Tiger
List price: $124.95
Wingspan: 2m
Wing area: 595.7 sq. in.
Weight: 43.2 oz.
Wing loading: 10.44 oz. per sq. ft.
Airfoil type: 11% modified Clark-Y and polyhedral design
Wing construction: Built-up; pre-covered
Kit construction: Built-up; pre-covered

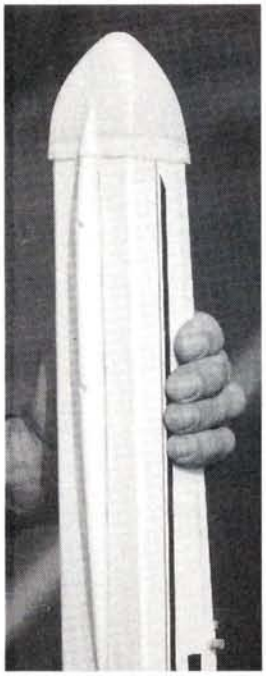
Features: this model is stable and slow enough for beginners, while being strong and versatile enough for intermediate pilots. The construction of all sub-assemblies is robust; all surfaces are pre-covered. Materials are high-grade plywood and balsa, and molded-plastic parts. Pushrods, nose cone and canopy are ready to install. Tail surfaces are already hinged.

Hits

- The wing is very strong, and its polyhedral design makes it stable and predictable in flight.
- Assembly time is probably less than five hours, depending on your skill level.
- This plane is slow and forgiving, so it's a good first model.

Misses

- Beginners might find the instructions slightly lacking in detail.
- The PVC film that Thunder Tiger uses is heavy and diffi cult to work with (when wrinkling or slackening occurs).
- The nose-cone mounting could be beefed-up to withstand hard landings.



The skid is attached with two screws. Note that the forward end fits into the nose cone.

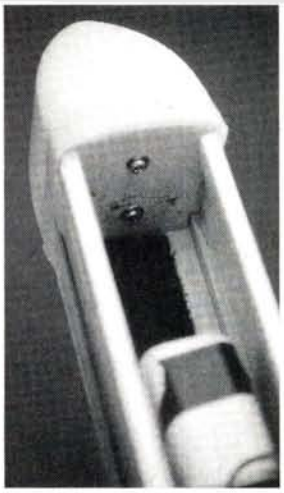
provided. Fit and drill mounting holes in the platform, then install the servos so that they face opposite directions. This will give the servo arms enough room to operate through their full range. The servo tray is glued into the nose section of the fuselage in front of the no. 1 bulkhead. Check the servo clearance from the bottom of the fuselage, and glue the servo tray into place.

The tow-hook position is already marked for you.

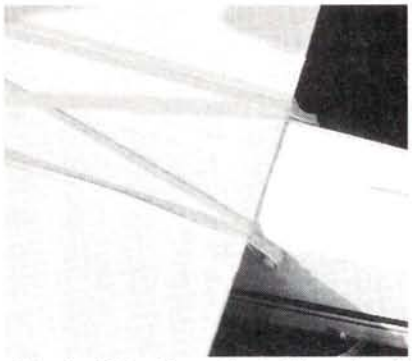
Routing the pushrods was the only procedure that gave me grief. There are pushrod-exit slots on both sides of the rear fuselage, but fishing their ends through the completed fuselage takes a lot of patience. Try attaching a thread to the pushrod's wire end to help guide them. When the pushrods are in place, attach a clevis to the threaded end. The forward end is inserted through a Carl Goldberg* E-Z connector onto the servo arm. Mount the control horns on the rudder and elevator in the positions indicated by the instructions. You might have to trim the elevator horn to prevent it from being lower than the fuselage bottom on landings.

Final assembly includes adjusting the control surfaces and arranging the radio gear. Adjust the control-horn clevises and the servo-arm mounting points until you achieve a rudder throw of plus or minus 3/4 inch and an elevator throw of plus or minus 1/2 inch. After wrapping it with foam, install the receiver under the wing saddle, just behind the no. 1 bulkhead.

The 450mAh battery is wrapped with foam and installed against the firewall. Having the battery in this position reduces the amount of lead ballast needed for balance. Balance the model right under the main wing spar. The kit includes a handy roll of thin, flat lead—more than enough. I used about 4 ounces, rolled and flattened and mounted against the nose-block bulkhead, under the battery.



The nose cone is mounted with two screws that go through the nose-block bulkhead.



Note the ABS strip on the trailing edge. It prevents rubber bands from crushing the trailing edge.

Now, using a small pair of scissors, carefully cut out the formed-plastic canopy, following the mold lines.

Thunder Tiger has produced an ARF (AIRF) that will get you airborne on the day you pull it out of the box. It's a forgiving platform for beginners and can be a lot of fun for more advanced pilots. Overall, I'd give the Explorer 2M a 95 percent on the "Fun-To-Fly Index."

*Here are the addresses of the companies mentioned in this article:
Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728.
Cirrus Ventures, 115 Hunter Ave., Fanwood, NJ 07023.
Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651. ■

FLIGHT PERFORMANCE

• Takeoff and landing

For initial flights, choose a calm day, or a morning with a light, constant breeze. After ensuring that you have frequency clearance, range-check your gear. Before hand-launching, check control-throw directions. Adjust all the trims and surfaces to neutral/flat. With a firm toss, launch the model into the wind. Adjust the trims to achieve a flat, straight glide.

With everything looking good, I hooked the Explorer onto the high-start and released it into the wind with a smart push—straight out. The model rose quickly and without much control input. At the top of the line, it simply slipped off the hook and began to glide beautifully. Only slight trim adjustments were needed to achieve a smooth transition and straight glide. Control inputs were smooth and responsive. Its polyhedral wing kept the Explorer very stable and predictable.

On landing, be careful to keep air speed up on approach turns. Slowing too much in a turn causes loss of rudder effectiveness. But the Explorer was forgiving, and it stabilized without losing much altitude. Landing speed was slow, but the glide ratio is high. Be careful not to overshoot your landing area!

• High-speed performance

The Explorer 2M is best suited to lazily circling and sniffing for hot air. But when it's time to scoot between one thermal and the next, just a touch of down-elevator makes it cover ground quickly.The controls became crisp and more responsive. The D-tube-structure wing is very strong; there was no deflection, even when pulling extra Gs out of short dives.

• Low-speed performance

Slow, lazy flying is the Explorer's forte. The flat-bottom Clark-Y airfoil lifts well at low speed. The polyhedral wing makes circling tightly in a thermal a joy. Just be careful to maintain enough air speed to keep the rudder working. Stalls occur at a very low speed and are always straight ahead. Recovery was immediate. You can tip-stall the airplane, but only in a really tight turn.

• Aerobatics

Although this glider can be forced into a roll, "hot-doggers" should look elsewhere for thrills. The plane will roll, but it isn't pretty. Just be sure you have plenty of room for recovery. Loops are easy; the airframe can take the stresses and stay in one piece.

I haven't tried it yet, but the Explorer should be fine for slope-soaring, too. Depending on wind velocity, some ballast may be required to get good penetration. Landing on top of a hill may be a challenge, though, because without spoilers or flaps, this airplane glides and glides....

AstroFlight News

Astro's New "Super" Chargers

Team Astro has redesigned the popular Model 112 charger to include peak detection and increased cell charging capabilities. The new 112PK "Super Charger" is a peak-detecting DC charger that can handle from 4 to 36 cells, 250 to 4000 mahr. It features a DC amp meter, a current adjust control for varying the charge rate from 1 to 5 amps, voltmeter jacks on the front panel to monitor your batteries' voltage, and an auxillary 100 mA trickle-charger to charge your reciever pack. The new 112PK also features a built-in cooling fan, and is input and output protected against both overload and polarity reversal

The 112 PK should be very popular with modelers charging anything from 3 and 4-cell free-flight packs all the way up to large 1/4 scale Cobalt 90 powered planes, high-powered boats such as the 32-cell Unlimited Hydros, and 14 to 20-cell drag racers using Team Astro Top Fuel 1 and II motors.

The new 112PK Peak Detector handles from 4 to 36 cells.

New Model 111XL AC/DC Charger

Team Astro's Model 111 charger has been improved! The new 111XL is a peak-detecting AC/DC charger that can charge from 1 to 8 cells on AC, and from 1 to 16 cells when using a 12V DC power source. It features a DC amp meter and a built-in DC/DC converter to eliminate false peaks caused by input voltage variation. The new 111XL also features a built-in cooling fan, and is fuse and diode protected against polarity reversal. The 111XL is short-circuit protected, and will not be damaged by shorting the output connections

The 111XL should be a hit with many modelers, including those charging 8-cell model helicopters, model airplanes up to 16-cells such as a Cobalt 25 powered Porterfield, R/C cars using the standard 4, 6, and 7-cell packs as well as 10 to 14 cell dragster packs, and R/C boat modelers in the 12-cell racing class. The 111XL is a versatile, dependable charger that works with household 110V AC or12V automobile batteries.

New Model 110XL DC Charger

Astro Flight's Model 110 charger has been upgraded with increased cell charging capability. The new 110XL is a peak-detecting DC charger that can handle from 1 to 16 cells, 250 to 4000 mahr. It features a DC amp meter, a current adjust control for varying the charge rate from 1 to 5 amps, and voltmeter jacks on the front panel to monitor your batteries' voltage. The new 110XL also features a built-in cooling fan, and is fuse and diode protected against reversal of the 12 volt DC input connection. The 110XL is short-circuit protected, and will not be damaged by shorting the ouput connections.

The 110XL should be very popular with modelers charging anything from 3 and 4-cell free-flight packs all the way up to large Cobalt 25 powered scale planes, high-powered boats in the 12-cell racing class, and 14-cell Open 1 Class truck pullers and Top Fuel drag racers using Team Astro Top Fuel 1 and II motors. □

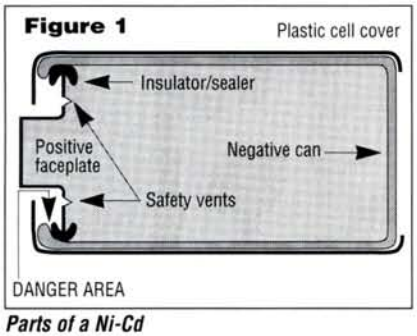
For more information, see your hobby dealer or call AstroFlight directly at (310) 821-6242.

Astro Flight, Inc. • 13311 Beach Ave., Marina Del Rey, CA 90292

KEITH SHAW

ON CONSTRUCTING A GOOD NI-CD BATTERY PACK

WHILE COMMERCIAL 6- or 7-cell Ni-Cd packs are abundantly available, the occasion arises for an odd configuration to fit a specific installation or a high-cell-count pack that is not a multiple of six or seven. At this juncture, it is time to learn to make your own battery packs. In addition, there are several advantages, such as knowing the exact brand and type of Ni-Cd you are using. The packaging of some of the commercial packs makes you think you are getting good Sanyo SCR cells, when, in reality, they are low-cost look-alikes. Who knows what lurks beneath that sinister shrink-wrap cover?



Parts of a Ni-Cd

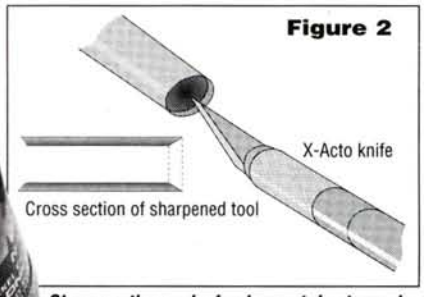
High-performance electrics demand that the cell interconnections have very low resistance. I've seen many commercial packs that are made with thin sheet-metal straps, poorly spot-welded to the Ni-Cd terminals. Due to the high resistance, the "interconnects" get so hot under discharge that the shrink-wrap melts away from them. (The SR* battery pack, which uses four spot-welds per connection and thicker sheet metal with a "strain-relief" crinkle, is an exception.) My preferred way to connect Ni-Cds is by soldering; however, some special techniques need to be learned to prevent heat from damaging the cell or shorting it out.

PROTECTING THE CELL

If you look at the positive end of any Ni-Cd, you will see the positive button and a flange of plastic shrink-wrap near the edge. Ni-Cds are constructed with an outer negative can and a positive faceplate that is sealed and insulated at one end. All high-discharge Ni-Cds have safety vents in the positive faceplate to prevent the possibility of explosion in the event that a cell is extremely overcharged. Under the lip of the heat-shrink cell cover is a dangerous region where the positive faceplate and the edge of the negative can are very close together. Any small piece of metal or a solder blob lodged there could easily cause a short. Since a shorted SCR Ni-Cd can easily produce a short-term current flow of more than 200 amps, things could get exciting *really* fast.

This 7-cell pack of Sanyo 1700mAh SCRC cells has been constructed using the techniques described in this article. Note the masking-tape bibs below the positive faceplates, the ¼-inch vinyl-tape strips wrapped around the cell ends, the heat-shrink tubing around the interconnects and the 12-gauge lead wire.

This Sanyo SCRC cell is ready for soldering.



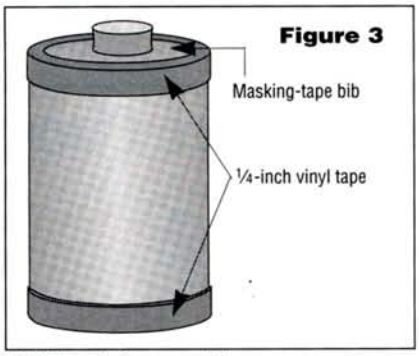
Sharpen the end of a brass tube to make the hole cutter.

To prevent this, I make a bib out of 1½-inch-wide, heavy-duty masking tape. Use an X-Acto knife to sharpen the inside edge of a piece of ⅜-inch-i.d. brass tube. Hold a piece of tape, adhesive side up, on a cardboard surface, and cut a hole in the center of the tape with the brass tube. Now put this onto the positive end of the cell and trim the excess flush to the outside edge. You should get a pretty tight fit around the center terminal. Don't worry about covering up the vents; if an emergency situation causes them to open, the gas pressure will easily push the tape out of the way.

It is better to buy Ni-Cds without tabs; however, if your cells do have tabs, remove as much of the tab as possible, and use a fine file to dress down the spot-weld burrs. The masking-tape bib will prevent any metal dust from getting under the flange. The material of choice for the interconnects is copper braid that

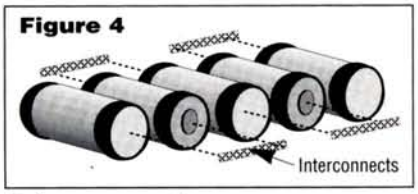
(Continued on page 44)

The author uses RG-59 coaxial cable as a source of copper-braid interconnects. Copper braid can also be purchased at hobby stores.



Ni-Cd ready for assembly.

is at least ¼ inch wide; 5/16 inch is even better. A lot of hobby shops carry tinned braid for the electric-car crowd, and it works OK. I use the shield stripped out of old RG-59 coaxial cable. It is a braided tube that is about 5/16 inch wide when flattened and is double thickness. *Do not* use rigid, bar-type interconnects for aircraft, as they can rip a Ni-Cd open in a crash, potentially causing a fire due to shorting, or at least a nasty chemical spill. The electrolyte in a Ni-Cd is a very strong base that is extremely corrosive and can cause severe burns.



Series arrangement.

ATTACHING CELLS

When Ni-Cds are used in extremely high-discharge-rate applications, or are overcharged, they can get hot enough to split the thin plastic cell cover. When this happens, cells can touch and create a short circuit that is quickly followed by total meltdown of the entire battery pack. *Never* glue the cells together or allow them to come into direct contact. Using ¼-inch-wide vinyl tape, wrap two or three layers around the ends of each cell. Now the cells can be arranged in the desired configuration and glued together—with CA on the tape only. Be sure the sequence is a series arrangement, i.e., the negative end of the first cell should be adjacent to the positive end of the second, the negative end of the second to the positive end of the third, etc.

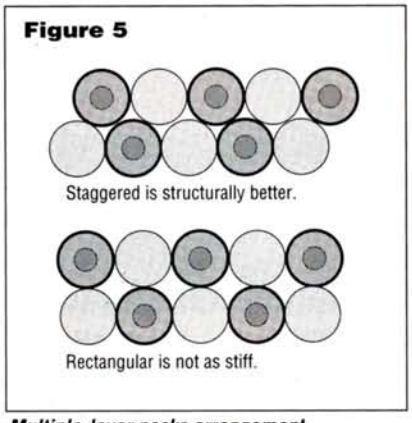
If you intend to stack several layers of cells, a staggered arrangement is structurally stronger than a rectangular one. To stabilize the pack, wrap a layer or two of ¾-inch-wide strapping tape around it.

SOLDERING

The next step is to carefully tin the ends of each cell. You will need a good soldering iron (*not* a soldering gun) with at least a 50W rating and at least a ¼-inch-wide chisel tip. This is very important; it is not only the temperature, but the heat capacity of the tip that will let us accomplish a quick solder joint. Ni-Cds "degrade" very quickly if they get too hot, so the solder joint must be made with an absolute minimum of heat conducted into the cell.

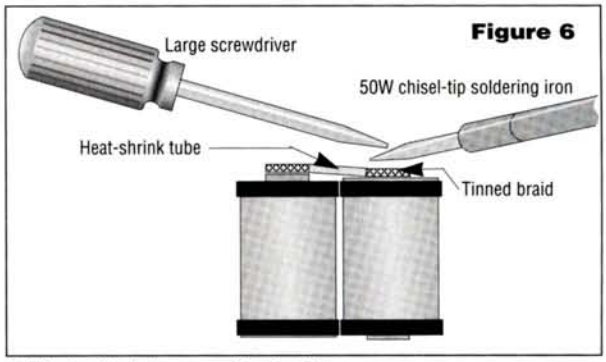
Scrub both ends of each cell with Scotch-Brite, a non-conductive abrasive pad available at any hardware store. Place the pack on its side, and put a small amount of flux on the center of the round end plates of each cell. It is best to use a good paste flux, such as Nokorode, or a zinc-chloride liquid flux, such as Stay-Clean. A good-quality rosin-core solder is necessary; I like Ersin Multicore or Kester 44.

Hold the solder across the end of the cell, put the flat part of the soldering-iron tip over it, and press down momentarily. If done correctly, it will take less than ½ second, and you should be able to touch the end of the cell in a couple of seconds. Use acetone or lacquer thinner and a tissue to clean off any flux residue, as the mentioned fluxes can be corrosive over time.



Multiple-layer packs arrangement.

Cut all the braid interconnect pieces to length and tin both ends. Unless you have developed "asbestos fingertips," it helps to hold the piece in the middle with needle-nose pliers. Cut ½-inch lengths of appropriate-size heat-shrink tubing, and slip them over each piece of braid. There is no need to shrink it at this time. Place the interconnects at the desired locations, and lightly tack them to the positive terminals. Only a very quick touch of the iron should be required.



Soldering the interconnecting braid.

Now, with the pack well supported or clamped down, hold a large flat-blade screwdriver in one hand and the iron in the other. Lay the flat surface of the soldering iron's chisel tip on the braid over the negative end of the cell, and press down firmly. As soon as the solder melts on both the braid and the cell surface, remove the iron and *immediately* press the screwdriver blade down hard. Even though solder is a reasonably good conductor, the copper braid is much better, so we want to get as much of it as we can as close to the surface as possible. The excess heat will be sucked up the screwdriver shank, protecting the cell from heat damage.

If done correctly, you should be able to touch the joint in one or two seconds. Do the other end of the braid similarly and continue with all of the other connections,

and, of course, those on the other side also. Although not absolutely necessary, you can clean up the ends of all the cells with acetone. If any of the small pieces of heat-shrink did not fully shrink, a MonoKote* heat gun will finish the job. If you need to do this, it is a good sign that the components are staying relatively cool during soldering!

WIRING

Finally, add the high-tech, mega-strand wire leads and connectors. If you can find it, use 12-gauge wire (13-gauge wire will work, too, but don't bother with anything smaller than 14 gauge), and either Sermos* connectors or Astro Flight* "Zero-loss" connectors. If you use silicone-insulated wire and plan to lay the wire across the top of the cells to get it to the other end of the pack, first put down a couple of strips of masking tape. The sharp ends of the braid solder joints could nick the wire and cause a short. I don't sleeve my packs with a heat-shrink cover, as I much prefer air-circulation cooling.

If you are concerned about risking brand new Ni-Cds, take apart an old, defunct, commercial pack, strip off the tabs, and try to build a mock-up battery pack to practice these techniques.

IN THE FUTURE

I'll try to write articles like this several times each year. Coming up are articles on making in-line-cell battery packs, various methods of mounting battery packs and techniques for mounting electric motors suitable for even the big 60 and 90 sizes. Look for them in *Model Airplane News*, the magazine that believes in the future of electric flight! Send your questions and comments to Keith Shaw, 2756 Elmwood, Ann Arbor, MI 48104.

**Here are the addresses that are pertinent to this article:*
SR Batteries Inc., *Box 287, Bellport, NY 11731.*
MonoKote; *distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826.*
Sermos R/C Snap Connectors, *Cedar Corners Stn., Box 16787, Stamford, CT 06905.*
Astro Flight Inc., *13311 Beach Ave., Marina Del Rey, CA 90292.* ■

'93 Toledo winner shares secrets

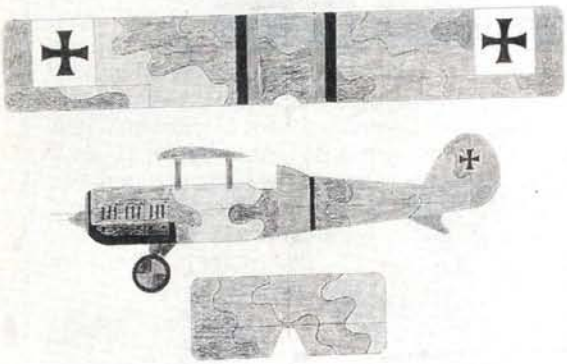
This is Faye Stilley's beautifully finished Deweyville Special. The kit, formerly kitted by Orline, was "bashed" by the Master and shows extensive customization.

HOW TO

Iron-On Camouflage

by FAYE STILLEY

PHOTOS BY FAYE STILLEY



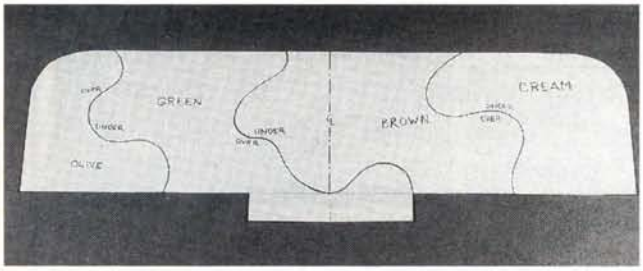
Editor's note: once again in the winners' circle, Faye Stilley took first place in MonoKote and in Sport Monoplane at the '93 Toledo show with his beautifully finished Deweyville Special. In this article, Faye reveals the technique that he used to cover his winning plane. If you'd like to know more about Faye's covering methods, read his book, "Covering R/C Airplanes," which is listed in the "Buyer's Mart" at the back of the magazine.*

Putting a camouflage color scheme over a solid surface such as a sheeted wing is fairly simple. Just cut out the patterns and iron on the various colors. However, seaming those wavy color separations together over an open framework is an entirely different challenge.

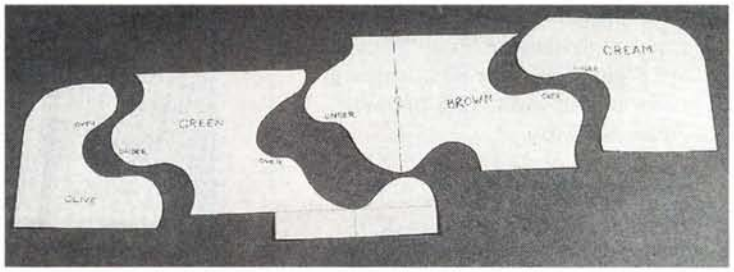
Here is a technique that works well and can also be used for other interesting color schemes. We are going to prepare a skin with the entire color scheme in place before covering the airframe. I chose Super MonoKote for this project because it offered the colors I wanted: olive, green, brown and cream. I also used the Top Flite* trim solvent to make seams between the colors. The numbered captions and the accompanying photos explain the technique.

(Continued on page 48)

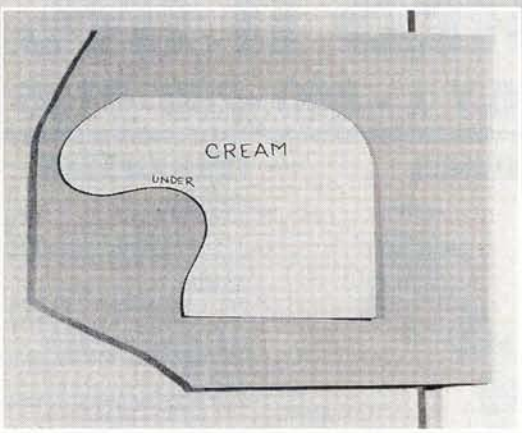
1. First: the plan. Scale down the plans to a size that's convenient for experimenting with the design. Then, doodle to your heart's content until you come up with something that you really like. For this camouflage scheme, I came up with this final sketch. I use colored pencils to give me an idea of how the colors will look when the whole design is put together.



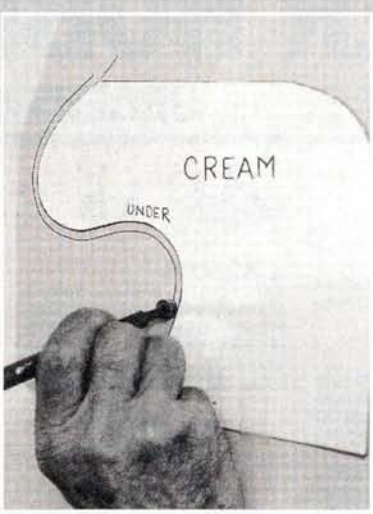
2. Once you're happy with the color scheme, make a set of full-size patterns. Enlarge the design from your sketch onto the full-size plans. Then, using carbon paper, make a pattern from poster-board, or if you prefer, put a Mylar sheet over the plans and draw your pattern.



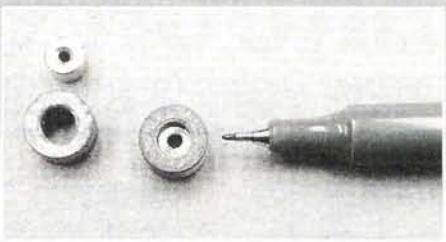
3. Darker colors should overlap lighter colors at the seams. At each seam, mark the pattern "under" or "over" so there will be no confusion later. Write the name of the color on each section. Cut the pattern into pieces—one for each color. This thing is starting to look like a puzzle. But don't worry, it will all come together later.



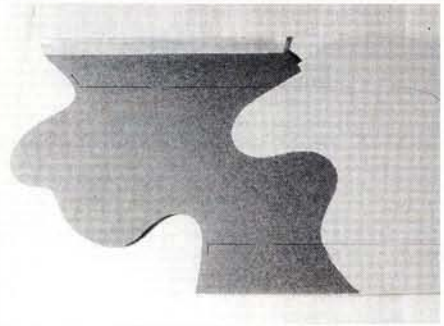
4. You are ready to begin cutting the film. Remove the backing, dampen a piece of glass and rub the film down firmly. Take the time to remove as many bubbles as possible. You won't be able to remove them all because moisture gets trapped under the film. But the flatter the film is, the more accurate your cuts will be. In the example, I started with a cream-colored piece. Note that this piece is on one tip of the stab, so extra material will extend beyond the leading and trailing edges and the tip. It will be needed later for pulling and shrinking the film.



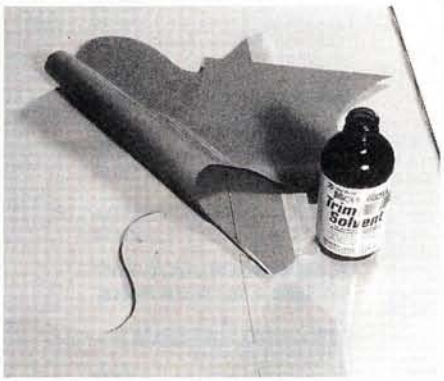
5. In this picture, the pattern is taped to the film and the outlines are being drawn. A spacer is used to create a 3/16-inch margin beyond the edge of the pattern line. This is for the seam. Notice that the pattern is marked "UNDER" on the side where the margin is. This indicates that the adjoining color will go over the margin to form the seam.



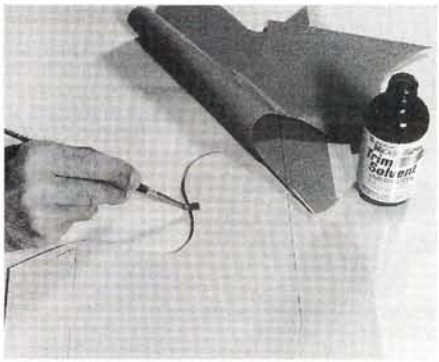
6. The spacer is easy to make. I simply pressed a 1/16-inch wheel collar into a 5/32-inch wheel collar. The space from the center hole to the edge of the larger collar turned out to be almost exactly 3/16 inch. The hole in the small collar was just the right size to fit the point of the marker that I used. It is important to use a fine-tip permanent marker because you will dampen the film; water-soluble inks will smear. The "permanent" ink is easy to clean off with alcohol or solvent, but dampness will not affect it.



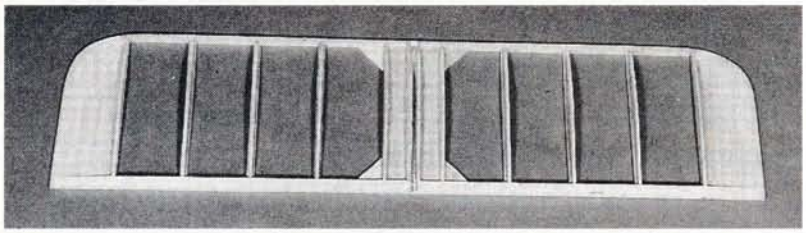
10. You are ready to make the first seam by attaching the second color to the first. Begin by placing the second color over the margin on the first. The positioning marks will help you make a seam of uniform width. It may take a few tries to get the exact position. When you do, rub the second color down as flat as possible and tape it to the glass on one edge. This piece of tape will serve as a hinge in the next step. It should be straight.



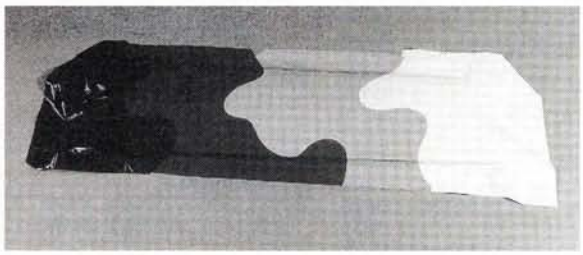
11. To seal the seam between the two pieces, I used Top Flite trim solvent. Fold back the piece of covering that goes over the seam to expose the covering that goes under the seam.



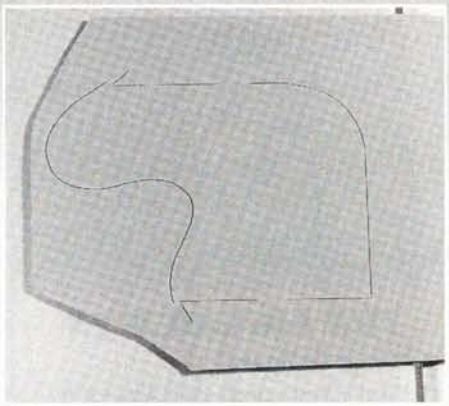
12. With a small brush, apply the solvent to the underlying covering. Apply a very thin coat, because it attacks the adhesive quickly. If the solvent is too wet, it will discolor the film on top of the seam. Don't worry about getting the solvent beyond the seam on the underlying film, but avoid getting it on the glass. You really don't want the film to stick to the glass because when you pull it off, it will leave the color on the glass.



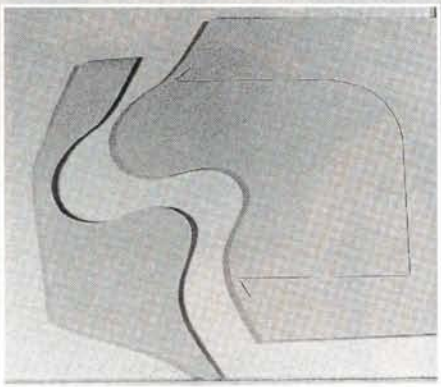
16. Sand the stab to its final shape and clean it thoroughly with a vacuum cleaner and a tack cloth. You are now ready to cover it.



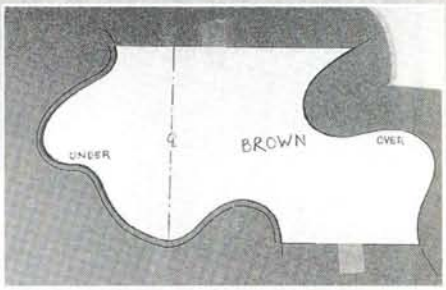
17. To prepare for shrinking, tack the skin in place. Do the tips first because they will require much more heat than the section over the ribs. I adjusted the design to allow one color to cover the entire tip. This is because too much heat on any of the seams could cause it to come apart or move slightly and cause wrinkles.



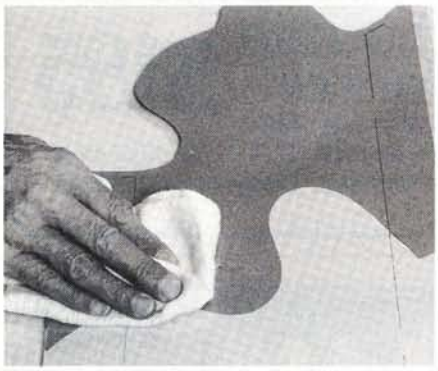
7. When the outline has been completed, remove the pattern. Notice the small lines above and below the outline. These marks help to position the next color. They were made at the pattern's edge rather than at the edge of the seam margin.



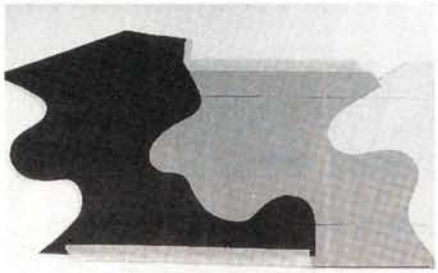
8. The film should still be firmly attached to the glass. This enables you to make the cut for the seam and trim away the excess. Cut only for the seam and NOT all the way around the pattern.



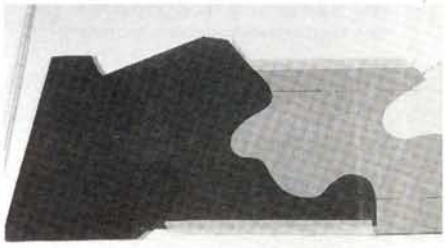
9. The second color, brown, is marked and cut in the same fashion as the first. Note that the edge of the second color is cut along the edge of the pattern where it's attached to the first color. This is because it goes over the first color to form the seam. However, it is lighter than the third color, so the spacer is used again to draw the cut line for the margin, which will go under the next color to form the seam.



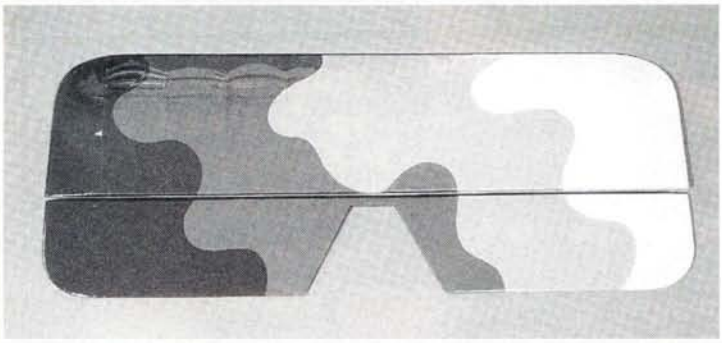
13. When you have brushed on a nice thin film of solvent, roll the second piece of covering into place. Use a soft cotton cloth to press it onto the first piece. As you roll the covering into place, rub it flat onto the glass. This will ensure that it goes back into place (where it was before you rolled it back). The tape "hinge" is there to help you do this.



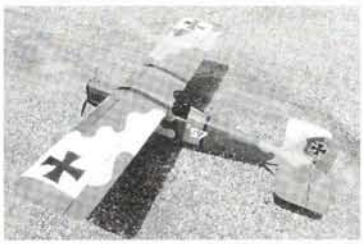
14. Next, add the third color. Note that the tape hinge was used on the bottom side. Either side would be all right, but I made the straight cut on the bottom side because there was more area to form a good hinge.



15. Now, add the last color. After it's sealed, carefully remove the tape hinges, beginning on the opposite side of the skin. This gives the last seam a little time to set before you remove the skin from the glass. Remove the completed skin and place it adhesive-side-up (shiny side down) on a flat surface. Allow it to cure for 24 hours.

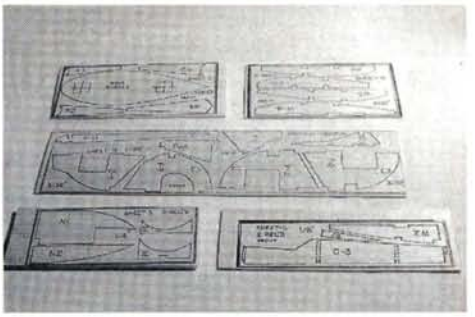


18. When you use the heat gun to do the final shrinking of the skin over the open structure, use as little heat as possible to get a smooth finish. Avoid blowing hot air directly onto a seam. If necessary, to shrink the covering near a seam, direct the hot air over the smooth side of the seam, NOT at the raw edge. Here are the finished stab and elevator.

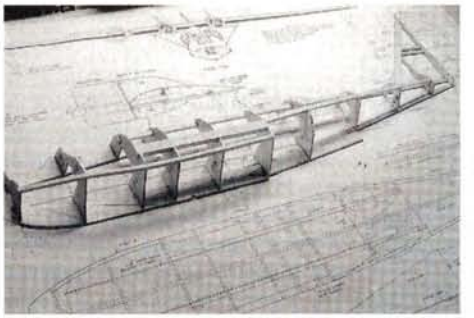


The trim solvent made strong, tight seams that couldn't be torn apart without destroying the covering material. This technique and your imagination allow unlimited decorating schemes, even over open framework. In a future article, I will discuss the technique I use to make insignias. Good luck on your next winning project!

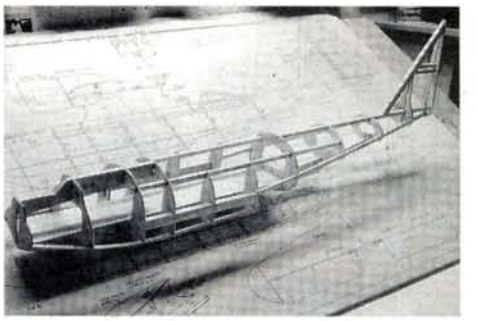
**Here are the addresses that are pertinent to this article:*
MonoKote; distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826.
Top Flite; distributed by Great Planes Model Distributors. ■



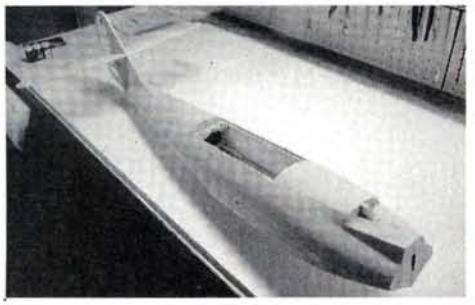
Most of the balsa parts are printed as outlines on balsa sheets; they have to be cut out with a sharp knife or a jigsaw.



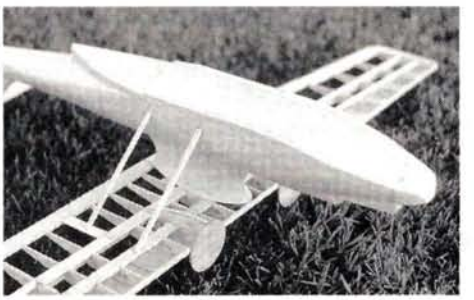
The fuselage is cleverly built in halves over the plans. Here, the left half is ready to be removed.



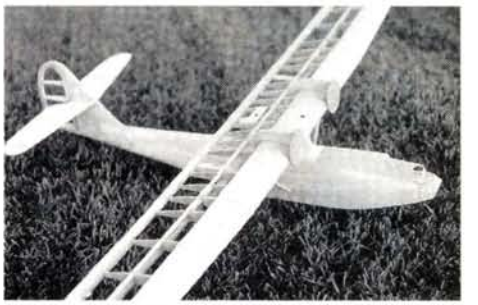
After the fuselage halves have been assembled over the plans, they're joined.



After much trimming, wetting, bending, gluing and sanding, the fuselage is completely sheeted with 1/16-inch balsa; the structure is surprisingly light.



The wing pylon is constructed from balsa blocks and sheets. Wing is mounted to the pylon with 10-32 nylon bolts, struts are 3/32x1/4-inch hardwood.



The completed airframe awaits the installation of the molded parts and the covering.

keep the kit's price reasonable.

The kit provides hardware for a fixed, tricycle landing gear, but because I thought the extra drag of this would hurt performance, and because the full-scale version for which the decals are provided didn't have landing gear, I elected to leave them off and opt for good ol' hand-launching.

CONSTRUCTION

The wing is built in three sections: a center and two outboards. The outboard sections were secured to the center section with six braces that had to be cut out of a sheet of 3/32-inch plywood. I used thin and medium CA to assemble the wing and the rest of the model. Epoxy isn't necessary.

I carved the wingtips out of solid balsa blocks and sanded them to the shape shown on the plan's cutaway views. The rudder has to be pieced together with the printed parts and then block-sanded on the sides and the leading edge.

After transferring their shapes from the plans, I cut the stab and elevator out of a sightly oversize 3/16-inch balsa sheet. The 3/32-inch-diameter elevator joining wire seemed a little too heavy for an airplane of this size, so I substituted 1/16-inch wire.

The fuselage is basically built in halves. The left half is assembled over the plans; then the instructions suggest that you build the right half directly onto the left half, while supporting the left half in some sort of cradle. I elected to turn the plan over, spray it lightly with Pam cooking spray (to make the image show clearly through on the reverse) and build the right side over the plans, too. That way, after I had assembled both sides, I was able to glue them together and to form a very true fuselage.

After piecing the keel, top stringers and fin parts over the plans as instructed, the 12 fuselage formers, which had been cut out earlier, were aligned and glued into place. The instructions then called for the insertion of a 3/16x1/4-inch basswood rail in some of the formers, but I couldn't find any basswood that matched the description. A trip to the scrap pile netted a balsa replacement; I decided that balsa would work well enough here. The last few stringers—including the bottom/outside stringer—were added to the sides. The last stringer had to be bent quite radically, so I made several relief cuts in it before attaching it.

After I had built the second half of the fuselage on the back of the plans, I glued it to the first half and then installed the 1/16-inch-thick radio-compartment base. At this point, two flexible pushrod sheaths (not included) had to be installed and routed to the elevator and rudder.

The next chore was the "planking" of the fuselage using 1/16-inch balsa and thin CA. I began by sheeting the bottom (the hull), where the straightest lines were. To support the 1/16-inch sheeting, I then installed 1/16-inch balsa

SPECIFICATIONS

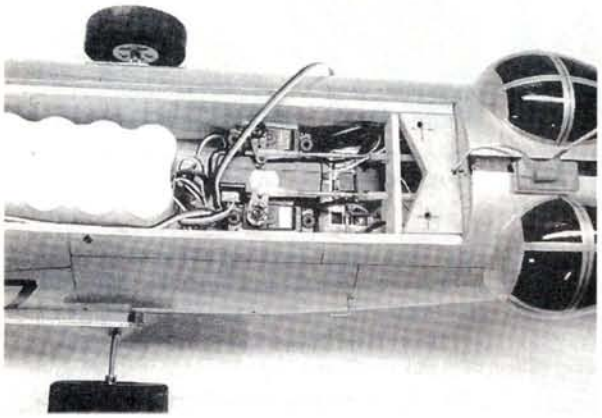
Kit name: PBY Catalina
Type: Scale electric twin (land-use only)
Manufacturer: Easy Built Models
List price: $65.00
Wingspan: 56 in.
Wing area: 378 sq. in.
Weight: 62 oz. (review model with motor and battery)
Wing loading: 23.5 oz. per sq. ft.
Length: 36 in. (approximately 1:22 scale)
Motors used: Two 035 motors
Battery req'd: 10 cells recommended (800 to 1200mAh)
Props: 2 Graupner counter-rotating 7x4s (one tractor and one pusher)
No. of channels req'd: 4 (3 servos and a speed controller)
Radio: Futaba Conquest 5-channel with mini-servos and battery

Features: all-balsa fuselage with 1/16-inch balsa sheeting; open-frame wing; molded engine nacelles and cabin windows; water-activated decals; wire parts included for fixed tricycle gear.

Hits
- Good-quality balsa.
- Excellent decals.
- A very handsome craft.
- Looks great airborne.

Misses
- Some balsa missing or wrong size.
- Plans and instructions are good enough for experienced builders, but not for beginners.
- Not easily adaptable to water flying.

The Astro 035 motors rest on balsa mounts and are secured with nylon tie-straps. The cowls and engine nacelles are molded plastic. Notice the "pusher" prop on the left motor.



The 10-cell battery takes up most of the radio compartment, so a mini radio is a must. The speed controller (not shown) rests on Velcro® just in front of the battery.

stringers every ¾ inch or so along the fuselage. With lots of trial and error, the remaining sheeting was then cut and attached. To help bend the balsa around the curves, I moistened it frequently with water from a spray bottle.

The wing pylon was pieced together out of numerous balsa blocks and sheets and then carved and sanded...and carved...and sanded...and carved...and sanded...and carved...and sanded...until it reached its final shape. The two bottom blocks (which make up the fuselage hatch) were added to the bottom of the pylon and carved to the shape of the fuselage top.

The wing was then mounted on the pylon and the pylon was mounted on the fuselage (all done with 10/32 bolts—not included). The four 3/32 x¼-inch hardwood wing struts were rounded and then mounted between the fuselage and the wing.

Next, I cut the molded parts roughly to shape and trial-fit them. The molded nose cone was too small, so I replaced it with a carved balsa block.

COVERING

The instructions suggest the use of tissue and dope covering, but I chose to sacrifice a gram or two and use Top Flite's* MonoKote: "Frosted Aluminum" for the fuselage, tail and wing bottom, and "Cub Yellow" for the top of the wing (to duplicate a pre-WW II aircraft scheme). The supplied decals have to be dipped in water and are easy to apply.

The nacelles are painted with Testor's* silver spray paint (remember, it doesn't have to be fuelproof!) that matches the aluminum MonoKote perfectly. Before installing them, I painted the insides of the windshield and the rear blisters black. The railings are MonoKote strips, which were carefully applied with a trim tool.

MOTOR INSTALLATION

The motor mounts are made up of ⅛-inch sheet balsa and ½-inch triangle stock (not included). I sanded them to obtain the required 2.5 degrees of upthrust, but I decided not to go with the recommended right thrust, because counter-rotating the props would cancel out any induced torque and subsequent yaw effect. The twin Astro Flight* Cobalt 035s are held on the mounts with nylon tie-straps.

RADIO INSTALLATION

To save weight and ensure there's enough room for the motor battery, a mini radio is a must. For elevator and rudder, there are two Futaba* S-133 servos mounted in the fuselage; for the ailerons, there's a servo in the wing. A 250mAh battery pack provides radio power.

The Astro Flight no. 207 speed controller and the 10-cell SR 1100-Max motor battery are held on the floor of the radio compartment with two strips of Velcro®.

CONCLUSION

Easily a month of evenings went into completing this project. But when, on that first flight, I saw that beautiful PBY silhouette against a Florida sunset and heard the faint "zzzz" of two electric motors in perfect synchronization, it was suddenly all worth it!

The kit has a few flaws; it certainly isn't for beginners); but it's well worth the effort!

I thank Ron Parchment, who provided fast legs for the initial hand-launches and acted as pilot when I was taking in-flight photos. I also thank Astro Flight and SR Batteries* for making recommendations and helping with what turned out to be a perfect power system.

**Here are the addresses of the companies mentioned in this article:*
Easy Built Models, *Box 425, Lockport, NY 14095-0425; (716) 438-0545.*
Top Flite; *distributed by Great Planes Model Distributors, P. O. Box 9021, Champaign, IL 61826.*
Testor Corp., *620 Buckbee St., Rockford, IL 61104.*
Astro Flight Inc., *13311 Beach Ave., Marina Del Rey, CA 90292.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
SR Batteries Inc., *Box 287, Bellport, NY 11713.* ■

FLIGHT PERFORMANCE

• Takeoff and landing

The Astro no. 207 speed controller brought the two counter-rotating props up very smoothly and in perfect synchronization. When full power had been reached, my launcher ran briskly for about 75 feet, and the PBY literally flew out of his hand and began a 20-degree climb. The two Astro 035s provided enough excess power to allow me to promptly reduce the power to two-thirds (to extend the flight time), and it still had a good climb rate.

Unfortunately, the first landing *wasn't* so perfect. I set up to land in the grass between the paved runway and a safety net. As I pulled the power to idle (or "off"), the PBY began a higher-than-expected sink rate. (A wing loading of 23.5 ounces per square foot is fairly high for a model of this size.) With the PBY about to touch down on a concrete pad, I added a burst of power and a little up-elevator at the same time. *Big mistake!* It suddenly snapped almost 90 degrees to the right and almost cartwheeled. With full opposite *everything* I managed to level the PBY out inches above the ground. Unfortunately, while on its side, it had struck the safety fence and its wing had suffered minor damage.

By holding a little more power and speed on final, and pulling the power and making a brief flare just before touchdown, I ensured that subsequent landings were much less eventful.

• High-speed flight

Full-power flight is only slightly faster than half-power flight, and it reduces flight time considerably. At reduced power, the SR 1100-Max batteries allow 5- or 6-minute flights—not bad for electric power.

• Low-speed handling

Throttled back for maximum duration, the PBY is surprisingly stable and scale-like, and it looks beautiful in the air. The small ailerons provide enough response at cruising speed, but they're somewhat sluggish at takeoff and landing speeds.

Normal power-off stalls are very gentle and easy to recover from, but when given power and too much elevator (as on my first landing) during them, the PBY can snap-roll in a heartbeat!

• Aerobatics

Forget it! I don't think the wing was desiged for aerobatics, so I've limited my showing off to low passes down the runway and gentle chandelles at the end. But if you beefed-up the wing and you *really* wanted to, you could probably use full power and coax a loop or roll out of it—but at the expense of precious flying time.

by DAVID GIERKE

Saito FA-50

ENGINE REVIEW

Real Performance Measurement:

In-Flight Testing

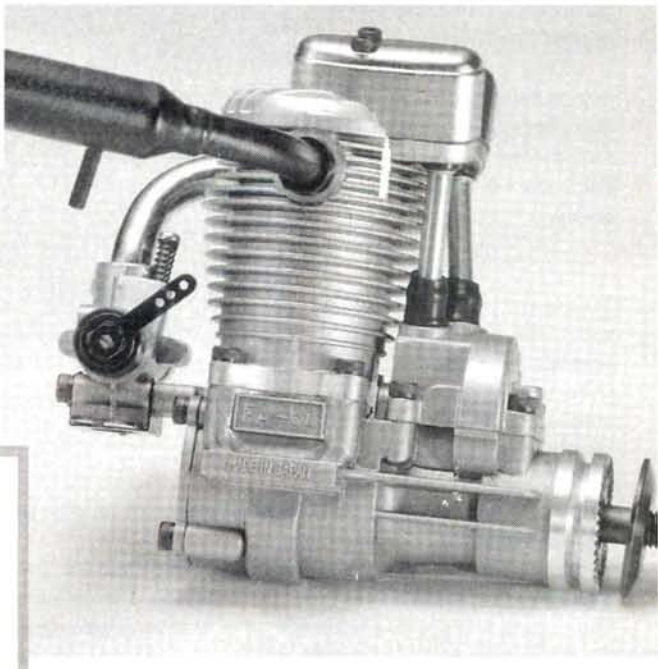
PHOTOS BY DAVID GIERKE

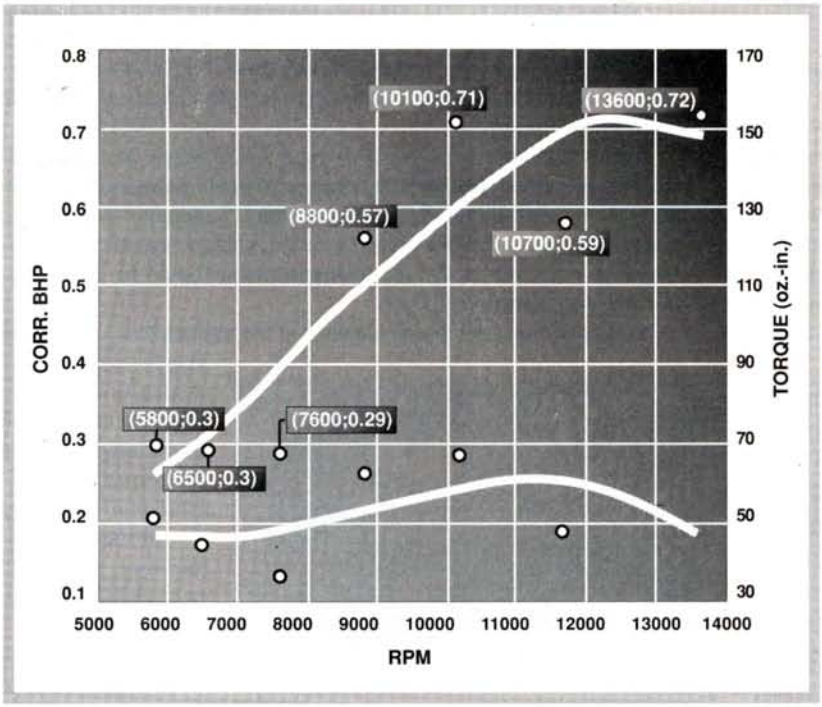
BACK IN 1982, Peter Chinn tested and reviewed the Saito* FA-45 MKII, 4-stroke engine for *Model Airplane News*. That engine incorporated many of the features found in the current test subject, the FA-50. The question, "Why a 50-size engine?" is undoubtedly answered by the never-ending quest for higher horsepower.

The FA-45 produced .51b.hp at 11,400rpm. Our current FA-50 produces .71b.hp at 12,500rpm. So, you ask, what's the difference between the two engines? To begin with, the bore has been increased from 22.4mm (.8819 in.) to 23.4mm (.9213 in.) while leaving the stroke unaltered at 19mm (.7480 in.). This changes the stroke/bore ratio from .848:1 for the 45 to .812:1 for the 50, i.e., the engine is becoming increasingly "over-square." Conventional wisdom suggests that the traditional low-rpm torque of such an engine will suffer, while the b.hp peak will tend to occur at higher rpm. In this case, as I'll show later, conventional wisdom is probably correct.

A compact, light, 4-stroke engine.

The earlier FA-45 had a ringed, high-silicon, aluminum piston running in a steel-lined cylinder with integral head. An earlier Saito design used a ringless piston of AAC design (aluminum piston with a chromed-aluminum crankcase bore). This design had a detachable head; it's now considered to be a collectors' item.





The current FA-50 engine also incorporates the AAC cylinder with ringed, high-silicon piston. The plating process must incorporate a brass-plating step, because the bottom outside of the cylinder flange looks like a conventional ABC setup (aluminum piston with chrome-plated brass cylinder) with a brass ring showing. The engine is also fitted with a choke valve for remote operation. The manufacturer suggests that castor-oil-based fuel be used with an oil content of about 20 percent, and the Saito P-2 and P-3 glow plugs are recommended.

It is also suggested that the engine be used for models weighing up to 6 pounds (2.8 kilograms).

The engine uses muffler pressure for reliable fuel delivery. The carburetor is of the twin-needle type,

DYNAMOMETER RESULTS

RPM	Torque	Corr. b.hp	b.hp	Corr. factor	Distance	Coefficient	48.77
5,000						Wet Bulb (F)	57
5,800	51	0.30	0.29	1.04	1.044	Dry Bulb (F)	70
6,500	45	0.30	0.29	1.04	0.931	Bar Pres (Hg)	29.23
7,600	37	0.29	0.28	1.04	0.758	Vap Pres (Hg)	0.31
8,800	63	0.57	0.55	1.04	1.284		
10,100	68	0.71	0.68	1.04	1.396		
11,700	49	0.59	0.57	1.04	1		
13,600	51	0.72	0.69	1.04	1.038		

and it has been "adjusted" at the factory. The second needle consists of a small slot-type brass screw that is screwed out (counterclockwise) for richening and in for leaning. With the increased cylinder displacement, the FA-50 weighs the same as its predecessor: 14 ounces (398 grams).

I didn't disassemble the engine before operating it this time, because it had been previously run by the magazine for one of its product reviews.

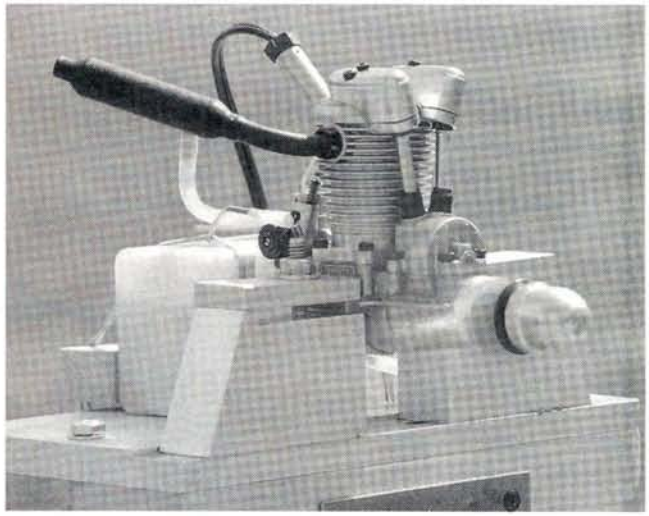
This offers a good view of the load beam no. 20, and the auxiliary cooling now necessary to perform a dynamometer test.

BREAK-IN

To confirm that the engine was really broken-in, I ran it through my standard procedure for 30 minutes. This consisted of fitting the FA-50 with a light-load propeller (Zinger* 10x6) and the Sig* 10-percent-nitro 4-stroke fuel, which contains 16 percent lubricating oil (half Klotz; half castor).

The engine was started and run rich at 10,000rpm for three-minute intervals after which it was shut off and allowed to cool completely. After about 18 minutes of this type of operation, where the main needle valve was gradually turned in (leaned) toward maximum power, the engine peaked at 12,300rpm. After half an hour, the engine ran steadily at full throttle. Test-stand dB levels were in the neighborhood of 95.5. The noise seems less because our ears are tricked by the low frequency of the exhaust note (half the exhaust operations compared to a 2-stroker at the same rpm).

The FA-50 exhibited quite a bit more compression after the break-in than it had at the beginning. Apart from a muffler pressure line that refused to stay on the muffler fitting early in the break-in period, everything ran smoothly. My early attempts to get a low, smooth idle were thwarted by the light-load prop. The best I could do was 3,500rpm. Later, I decided to set the idle with our heavier-load flying props.



Operating at a steady 12,300rpm, the FA-50 nears completion of break-in.

DYNAMOMETER TEST

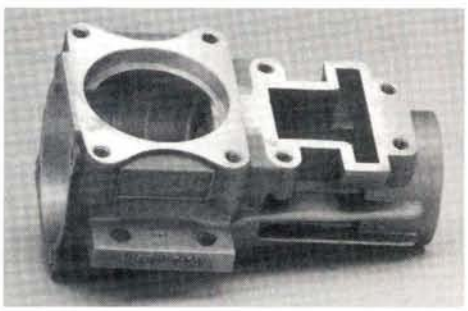
Before I test each new engine, the dynamometer must be calibrated for accuracy. This involves the relatively simple process of mounting the engine, disconnecting the vibration-damping dashpot from the torque arm, and suspending gram weights from the calibration wheel. From all of this, I determine the torque coefficient of each engine tested.

The re-calibration is necessary because every engine has a different weight and muffler size, and that changes the zero point on the pendulum graph (see sidebar for further details). I mention this only to emphasize my concern for accuracy. If I'm going to spend two to four hours on a test procedure, the instrumentation should be in the best possible condition to do the job.

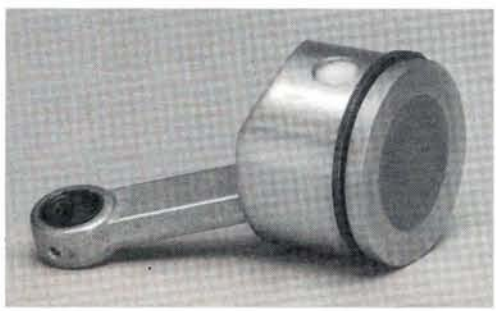
As it turned out, the torque obtained at the various load rpm for the FA-50 were highly scattered. As an example, if you look at the torque value at 7,600rpm, you will find that it is only 37 ounce-inch. At the time, I thought I had made a mistake at this load point.

Previous experience with 4-stroke

(Continued on page 62)



A unique view of the FA-50's crankcase—beautiful machine work.



Connecting rod, piston and compression ring showing little wear after three hours of running.

CALCULATING BRAKE HORSEPOWER (b.hp)

Robert L. Angel, of Santa Maria, CA, and others suggest that I explain some of the technical aspects of dynamometer testing.

At the risk of oversimplifying because of space constraints, I will attempt to clarify key concepts concerning the procedures. I will address these procedures in the column from time to time, as demand warrants and space allows.

• **Horsepower** is a calculated value. "Brake horsepower" means that it has been determined experimentally on a dynamometer. Brake horsepower is the product of torque and revolutions per minute (rpm) of an engine's rotary output crankshaft. The rpm part is easy; any good tachometer will do. The torque part is more complicated. To begin with, torque is a twisting force. Torque (T) is determined by multiplying a force (F) times a radius (R).

Example: assume you are tightening a nut with a wrench. If there is 1 foot between your hand and the nut, and you push with a force of 20 pounds, you will be exerting 20 pound-feet of torque (T=FxR). Almost all dynamometers measure the torque of an engine by converting the rotary torque of its output shaft into stationary torque. This is fortunate for us; it would be difficult to attach a force scale to the shaft of an engine turning 10,000rpm, wouldn't it?

Stationary torque works like this: as our engine shaft spins counterclockwise at, say, 10,000rpm , there's an equal and opposite force trying to spin the engine and its mount in a clockwise direction (remember Newton?). This is called "reactive torque," and it's a tricky way to get the job done.

Actually, there are many types of "dynos," but most of them use this simple idea. Stationary torque for a typical, small, high-speed engine dyno (sometimes called a fan brake) is measured by a force scale at the end of a beam, or as in my case, a deflected (against gravity) pendulum weight (see illustration). By mounting the engine on a "limited-rotation" torque shaft, a means of measuring stationary torque has been provided.

BRAKE HORSEPOWER (b.hp)

Mathematically, here's how the b.hp equation was derived:

1. Work = Force x Distance

2. Power = Work x rpm

3. Power = Force x $2\pi r$ x rpm

($2\pi r$ = circumference needed for rotary work)

4. $$\text{Power} = \frac{\text{Force} \times r}{\text{Torque}} \times \text{rpm} \times 2\pi$$

5. Power= Torque x rpm x 2π

6. $$\text{Horsepower} = \frac{\text{Power}}{33{,}000 \text{ft. lb./min.}}$$

7. $$\text{Horsepower} = \frac{\text{Torque} \times \text{rpm}}{5{,}250}$$

(This is in terms of lb.-ft. of torque)

8. $$\text{Horsepower} = \frac{\text{Torque} \times \text{rpm}}{1{,}008{,}000}$$

(This is the equation that I use; .it's in terms of ounce-inch of torque)

As an example of how the equation works:

1. At any given load (propeller size), the engine is turning at 10,000rpm, as measured by the tachometer.
2. The pendulum at the end of the torque shaft deflects, say, 3.150 inches at its bottom, where I have mounted a chart. I use a solenoid with a marker attached; the marker strikes the chart at the push of a button. The distance is accurately measured using dial calipers after the engine has been shut down. I have calibrated this pendulum with hanging weights of known value from a 5-inch-radius wheel at the rear of the torque shaft. I have determined that it requires 49.1 ounce-inch of torque for each inch of deflection at the pendulum-graph strike point.

Frank Vassallo has calculated that this coefficient holds true for the first 20° of pendulum rotation from the vertical. Anyhow, 3.150 inches x 49.1 ounce-inch = 154.7 ounce-inch of torque.

3. Substitute the rpm and torque figures into our equation to find b.hp.

$$\text{b.hp} = \frac{\text{T} \times \text{rpm}}{1{,}008{,}000}$$

$$= \frac{154.7 \times 10{,}000}{1{,}008{,}000}$$

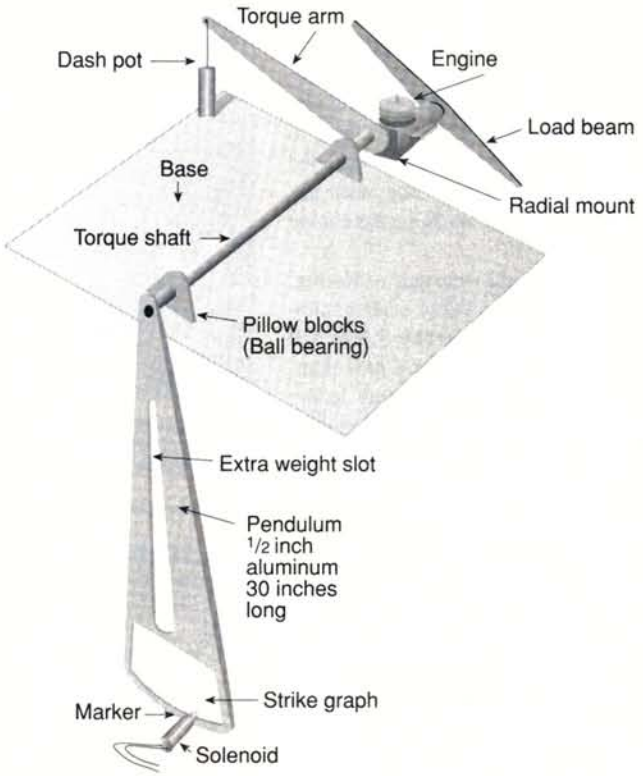
$$= \frac{1{,}547{,}000}{1{,}008{,}000}$$

$$\text{b.hp} = 1.53$$

So, what have we found out about dynamometer testing? Take a look at this month's engine-test data table. You should be able to identify the following: rpm, torque, b.hp, coefficient, distance (pendulum).

Next time, I'll discuss how we neutralize the constantly changing effects of atmospheric conditions on engine performance. You will see how wet- and dry-bulb temperatures, along with the barometric pressure, produce a so-called "correction factor" that enables us to determine corrected brake horsepower.

Fun stuff, huh?



Dynamometer Calibration

For each engine to be tested:

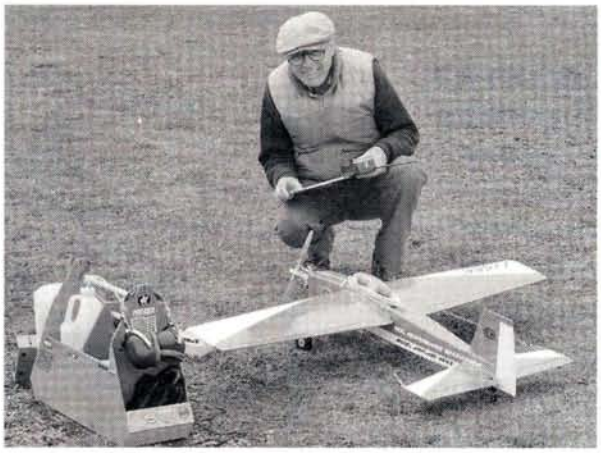
1. Mount engine-muffler/tuned pipe.
2. Disconnect dash pot from torque arm.
3. Decide on torque range needed.
   • Add or remove pendulum weight.
4. Adjust the strike distance to the pendulum graph.
5. Strike zero point on the pendulum graph with solenoid-actuated pen.
6. Attach 5-inch-radius calibration wheel to rear of torque shaft.
   • Suspend weight container (65g) from calibration wheel by a string.
   • Add gram weights to the container until the torque arm (front) is almost completely deflected.
   • Strike this point on the pendulum graph.
7. By finding the product of this total weight and the calibration-wheel radius, the system's torque capacity is determined, i.e., calibration container weight—65g; weight added for total deflection—820g; total weight—885g.
   885/28.35=31.22 oz. x 5.0 in.=156.1 oz.-in. (torque capacity)
8. Using dial calipers, accurately measure the distance between the two Strike points.
   • Divide this distance, i.e., 3.185 in., into the torque capacity (156.1 oz.-in.): 156.1 ÷ 3.185 = 49.01 oz.-in. / in. This number represents the torque coefficient for this specific test.
9. To determine the torque during a load test, multiply the torque coefficient by the pendulum-arm deflection: 49.01 oz.-in. / in. x 1.5 in. = 73.5 oz.-in.
10. Re-attach dash-pot arm.

engines had indicated a strong low-rpm torque peak. This engine displayed a tendency toward peaking at a much higher rpm. The initial drop in torque at 6,500 and 7,600rpm signaled that something was wrong with my procedure, the apparatus, or the engine itself.

Try as I might, through re-testing, the strange torque-value scatter stubbornly held true between 7,600 and 8,800rpm. Fortunately, my new computer graphing program came to the rescue in plotting a "best fit" curve for both torque and b.hp. Briefly, for all of you mathematicians out there, the least squares technique is accomplished by using the third-order-polynomial method. To my surprise, the torque was predicted to peak at about 11,000rpm. I must admit that I was skeptical! The flight testing would prove or disprove this set of performance curves that appeared to belong to a *2-stroke* engine!

I thank Mike Billinton for his unselfish help in the form of important suggestions toward the improvement of my dynamometer. Mike long ago recognized the deficiencies of using propellers for loading the engine during these tests. He pointed out that the corkscrewing propeller wash influenced the deflection of the pendulum weight and compromised my test results.

Mike shared all of the information necessary to construct "load beams" with me. Load beams are essentially non-pitched propellers that load the engine beautifully without producing the offending prop wash. When you see photos of the dyno, you will notice the auxiliary engine-cooling tube that is now required and the polycarbonate shield that's strategically placed between the engine and the load beam—all in the name of increased accuracy. Thanks, Mike Billinton!



Frank Vassallo—all smiles before the first flight of the season. Frank, a research engineer for the CALSPAN Corp., provides valuable technical insight for "RPM."

FLIGHT TEST—Saito FA-50

Prop (mfg. & size)	Ground rpm	Air rpm		True air speed mph	
		Loop	Straight	Loop	Straight
APC 11x6	11,500	11,500	12,400	39	79
APC 12x8	7,500	7,400	9,200	32	81
MA* 11x7.5	9,500	9,500	11,150	35	80
Rev-Up 10x6 EW	11,500	11,700	13,000	36	75
Graupner 12x7	8,500	8,250	11,300	31	78
Zinger 12x6	8,600	8,800	10,000	25	72

*Master Airscrew

Notes: airplane—L&R Airtrax 40; fuel—Sig 4-stroke, 10% nitro, 16% oil (8% Klotz, 8% castor). Sound at 9 feet—96dB; relative air density—97%; wet bulb—52°; dry bulb 60°; barometric pressure—29.31 in. Fuel consumption—.61 oz. per min. at peak b.hp (corr.); props that slowed to less than static rpm in a loop—Graupner 12x7; APC 12x8.

FLIGHT TESTING

This would be a bit of a white-knuckle first flight. A new airplane, new airborne radio, first flight of the season and a new, rather tight flying site. Other than the more than 20mph winds that buffeted the model about somewhat, everything went smoothly.

My new Airtrax* 40 model flew with only a touch of left-aileron trim. The new radio was solid, and the Condor Hobbies* telemetering system functioned flawlessly. Rob Roy of L&R Aircraft—makers of the Airtrax series of partially built kits—laughed when I informed him that the little 40 flew well (just like the big one—Airtrax 60).

Of course, he had to ask whether I had remembered to hook up the ailerons in the right direction! I responded that I again cut the nose off the model forward of the firewall. I know Rob hates to see the aerodynamics of his design tarnished, but certain sacrifices must be made for testing! When many different engines are to be bolted onto a firewall in a relatively short time, shaft lengths and spinner fits will drive you up the wall.

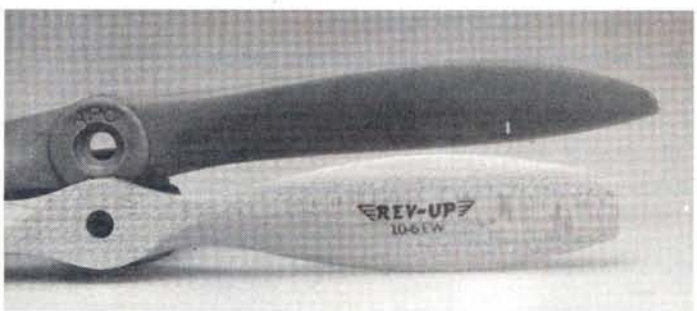
As you peruse the Flight Test chart, you will notice several important items:

- The APC 11x6 and the Rev-Up 10x6 EW operated closest to the torque peak in loops, and each had the highest respective loop speed. As you remember, peak torque rpm is 11,000.

The rather late-peaking torque curve appears to be correct (noting that the bottom three finishers in the speed through the loop test all had rpm of 8,800 or less).

- The highest air speed would be expected to have rpm close to the peak corrected b.hp figure of 12,500rpm. Third-place finisher in this

(Continued on page 108)



Comparing the radical differences between the APC and Rev-Up EW props.

Comparing the tip shape of the Graupner* and Zinger props.

PRODUCT REVIEW

Advanced helicopter flight simulator

by TERRY MOORE

Digital Wonderworks'

Skylark

PUBLISHED BY Digital Wonderworks*, the Skylark is an advanced computer flight simulator that's capable of realistically recreating the look and feel of an R/C helicopter. Obviously, a computer simulator won't produce the same spatial cues and feedback that a real model would, but it can help you learn certain maneuvers, e.g., inverted flight, inverted hover, FAI-style aerobatics and nose-in hover.

One of the reasons people fly helicopters is because of the challenge. Forward, backwards, sideways and inverted flight are all possible. I can tell you from experience that it can also be very expensive to learn to fly an R/C helicopter. The Skylark can pay for itself if it saves you from one major crash. At the time of this writing, I have used this software for 15 months. Here's a detailed look at how you can use the Skylark to improve your flying skills.

PHOTOS BY TERRY MOORE

In this view, Chopper 2 is selected along with the contest pad and cloudy sky. Note the solid-filled graphics. The helicopter reacts to control inputs and follows the sticks well, even when it's almost out of sight.

This is what happens when the heli gets too close. The danger warning can be turned off if you desire.

OPERATION

Several articles have already been written about the software, so I'll concentrate on the setup. Beginners can learn hovering skills and progress to nose-in hover. Intermediate pilots can improve their orientation skills and progress to switchless inverted and autorotation. Advanced pilots can learn backwards and sideways flight, and they can practice timing maneuvers, e.g., the rolling stall turn. They can also fine-tune sustained inverted hover.

The software parameters govern how the Skylark performs, and the degree of realism can be as close to the real thing as a simulation allows, with a couple of exceptions that will be noted later. The parameters are:

• **SW1 and SW2.** This switch and function menu turns on basic functions and assigns transmitter switches to operate, e.g., throttle hold, high-idle, gyro and V-curve throttle.

• **Cf.** This aerodynamics-coefficients menu changes some of the variables that the flight equations use to simulate the model's flight characteristics (see Figure 1).

• **P1 and P2.** Use this menu to control some of the physical characteristics and capabilities of the model, e.g., weight, collective response and control sensitivity (see Figures 2 and 3).

• **FILES.** This menu loads and saves setups, models and scenery.

• **HLP.** (help) The menu bar or a function key will access this menu.

• **SYS.** This menu changes screen color and deals with software registration information.

Full-power climb-out. It's easy to experiment with different power-to-weight ratios, fuselage dynamics, and cyclic/collective relationships.

This photo shows the helicopter just before contact with the ground. With the Skylark, you can learn orientations that easily translate into actual flying skills.

Changes to heli parameters can be made quickly. Menus pop up by using the space bar (there is no mouse, but mouse support isn't really needed), and you can return to exactly where you left off. In the latest revision (Version 1.03), a simple push of the "K" key will re-calibrate the cyclic stick without resorting to the full-stick centering routine or moving the transmitter trims.

The Skylark can be setup to simulate a trainer or a "wild thing"; it's your choice. I wanted to re-create the feel of the models that I flew, so I did a lot of experimentation. The default settings simulated a flybarless helicopter and, although this was fine at first, I quickly tired of the constant "pitch up" that this setup exhibited. The problem has been corrected in Version 1.03. The "Main Blade Differential Lift" setting under "Cf" controls the way the rotor head feels relative to a flybar-equipped or flybarless model. There's even a parameter setting that duplicates the feel of a flapping rotor head.

Because I fly an 11-pound helicopter, I had to set the aircraft weight at 5,000 grams. My model is equipped with 195-gram blades, and that setting is duplicated under "Main Rotor Blade Mass." One important parameter is the "Dynamic Scale Factor." I first noticed that when I performed a rolling stall turn, the helicopter seemed to go vertical forever. As you know, a model helicopter will go straight up, but the altitude that you can achieve is proportional to the drag of the helicopter, the amount of power available, the weight and your forward air speed at the time of entry. "Dynamic Scale Factor" will fine-tune the amount of vertical that can be achieved based on the previously mentioned factors. My setting was 120. If you're flying a fuselage machine, it's possible to simulate the streamlining effect by altering the "Aircraft Total Parasite Drag" under the "Cf" menu. Since the engines that I run are piped and modified, I used an engine setting of between 130 and 140 to simulate the power.

I use a little wind simulation to give me a feel for the real conditions that we all face every time we fly. Try 5 to 10mph with variability "on" at 5 or 10mph.

Beginner modes are available, but the simulation is so stable that I don't think these modes are needed. They also make the model somewhat unrealistic. It's more realistic to change the cyclic sensitivity and turn on exponential for a slower response. If you're presently using Compuserve, the Modelnet forum has several parameter files that have been up-loaded. I find it quite interesting to try them and compare them with the ones that I fly.

System Requirements

An 80386 SX-16 mHz CPU with a VGA color monitor and a VGA card is the minimum recommended platform for the Skylark. The software is available on 3.5-inch or 5.25-inch disks, and it also comes with a special game card, a modified JR radio and a detailed instruction manual. (This software should be run on a fast machine since the video needs to update very quickly.) The modified JR Apollo transmitter includes six additional programmable switches. It has a familiar feel with nice sticks.

CRITIQUE

The Skylark has a lot going for it: it's realistic, user-friendly, and it's IBM-compatible. Rod Gilson—the Skylark's author—is committed to updating the software and has shown a keen interest in user feedback. You don't have to know a cryptic language to program the software. Several friends of mine have used the Skylark to learn sustained inverted hover, nose-in hover and autorotations. The latest revision (Version 1.03) has autorotation parameters.

I've had more than my money's worth out of the Skylark. I've enjoyed using it, and it has helped with difficult orientations. To get the most out of your Skylark, you'll need patience. It takes time to adjust the settings to your liking. Although it can't replace a model, a simulator will sharpen your skills, and, no doubt, it will play an increasingly important role in our hobby. The creators of the Skylark and others like it are true pioneers.

**Here's the address of the company featured in this article:*

***Digital Wonderworks,** P.O. Box 3118, Ann Arbor, MI 48106; (313) 662-5275.* ■

Figure 1

Sw1	Sw2	**Cf**	P1	P2	File	H1p	Sys

Aerodynamic Coefficients Menu

Main rotor torque	100
Main rotor blade lift	100
Main blade differential lift	0
Main blade induced drag	100
Main blade process drag	100
Main blade profile drag	100
Main blade stall drag	200
Aircraft total parasite drag	100
Main rotor ring vortex	100
Tail 'weathervane'	60
Ground effect	100
Main blade stall angle	80
Tail rotor side force	100

Figure 2

Sw1	Sw2	Cf	**P1**	P2	File	H1p	Sys

Parameters Menu 1

Dynamic scale factor	110
Engine displacement	120
Aircraft weight	4800
Main rotor blade mass	390
Main rotor rigidity	30
Pitch momentum	80
Roll momentum	12
Yaw momentum	120
Ground effect limit	40
Heading gyro gain	100
Heading gyro limit	100
High idle setting	1200
Fuel consumption rate	0
Ground impact limit	100

Figure 3

Sw1	Sw2	Cf	P1	**P2**	File	H1p	Sys

Parameters Menu 2

Pitch response	65
Roll response	85
Yaw response	250
Collective response	120
Pitch control offset	0
Roll control offset	0
Yaw control offset	4
Collective control offset	-3
Wind speed	8
Wind direction (0 to 360)	0
Wind variability (average)	8
Stability (beginner switch ON)	20
Keypad increment (Xmit Sw OFF)	40
Keypad decay rate (Xmit Sw OFF)	40

Spacewalker II

1/4-SCALE WITH CLASSIC LINES

by EARL & BOB CARPENTER

AMERICANS TEND to think big. If big is good, then bigger must be better. When Sig Mfg. Co. initially brought out their Space-walker (based on Hazel Sig's full-scale version) it was big—really big. The company skipped right past the ¼-scale stage and jumped into ⅓ scale with the tremendously large Spacewalker.*

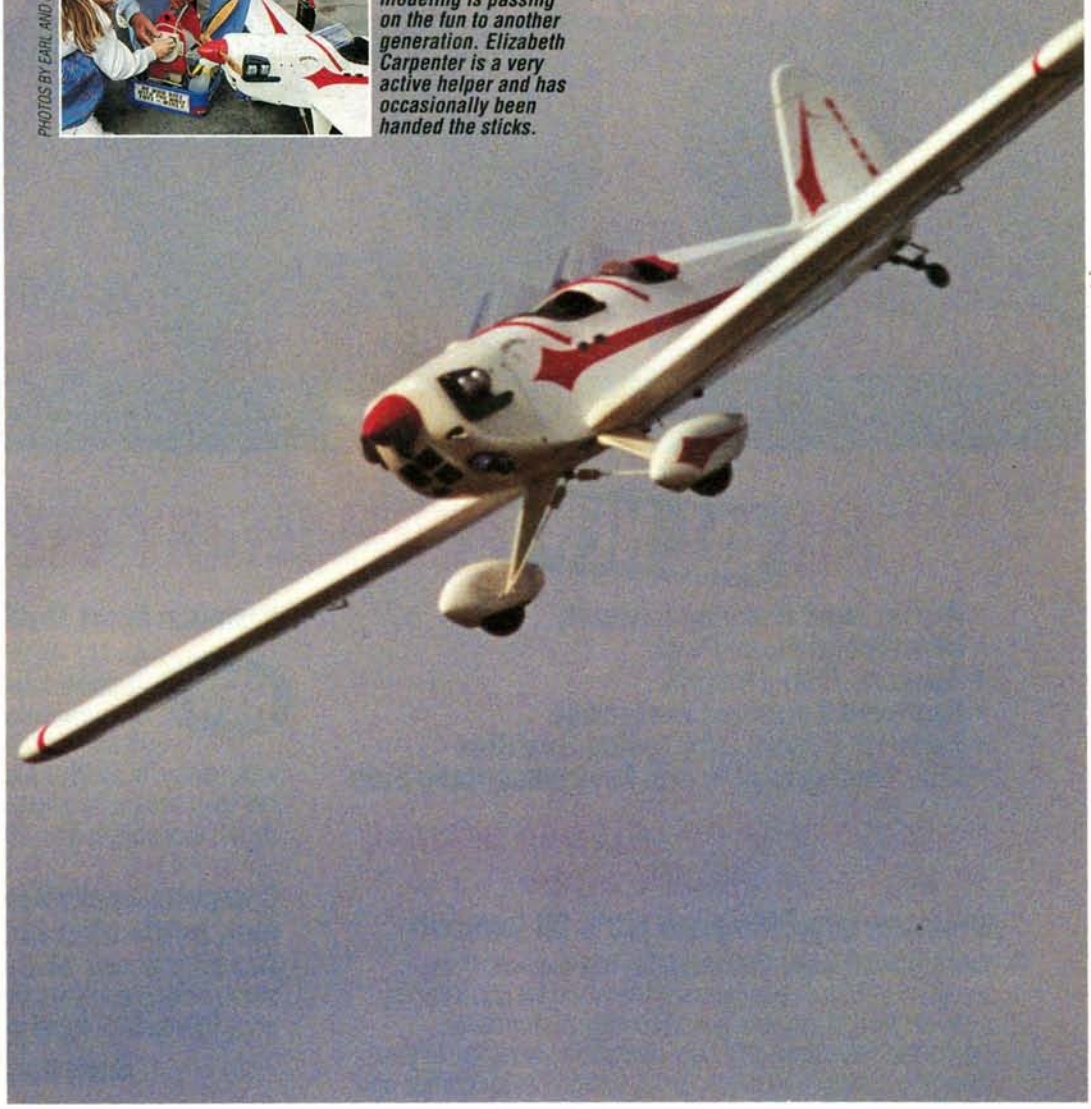
Bigger was great! A lot of fliers enjoyed the humongous model, but there was a substantial drawback. Its size, which many modelers find awkward, kept a big pool of potential builders and fliers at arm's distance. A ⅓-scale airplane just isn't a pick-up-and-go kind of thing.

The demand for a ¼-scale version of the pleasantly flying airplane grew as those who dared to venture into the truly giant-scale world relayed tales of ideal flight characteristics, sporty jaunts in the sky and a pleasant building experience as the icing on the cake.

But don't be misled. The ¼-scale version of the Space-walker II is plenty big. With its 7-foot wingspan and a 60.5-inch length, this craft is easy to identify in the sky. We were attracted to the Spacewalker II early on, and when the ¼-scale kits became available, we snatched one up and went to work in the shop.

PHOTOS BY EARL AND BOB CARPENTER

One of the joys of modeling is passing on the fun to another generation. Elizabeth Carpenter is a very active helper and has occasionally been handed the sticks.



FLIGHT PERFORMANCE

This plane was tested in a variety of conditions, from zero wind to strong gusts. It was also flown in very cold weather and in searing heat.

- **Takeoff and landing**
  On the roll-out, the Spacewalker II requires virtually no rudder corrections. With the torque of a big engine, the plane is ready to fly in just a few yards, but it will allow you to stretch that out if you want takeoffs to look more realistic. We were very impressed with its straight-line stability. You can almost forget that you're controlling a tail-dragger. Even novice fliers can stay within their comfort zone as they fly this airplane.

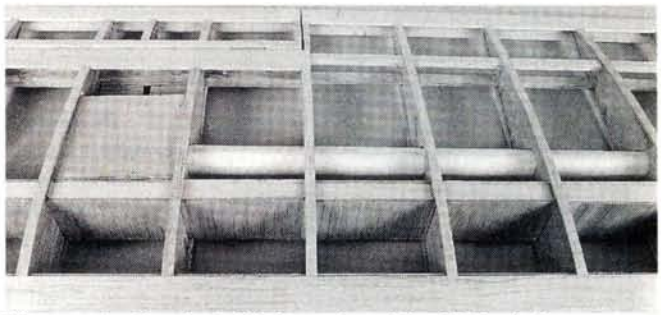
  Landings are just as predictable. The Spacewalker II likes to float and can fool you on the first couple of landings: it can hang in the air for what seems like an eternity. The best technique is to pull the engine to an idle when it's far from the runway and then guide the plane in slowly. There's no threat of tip-stalling or ill-handling at low speeds.

- **High-speed performance**
  With the throttle stick pressed firmly forward, the Spacewalker II can rip through any gyration you have in mind. We never thought it was necessary to adjust the trim when we upped the top speed to maximum levels. The Spacewalker II is truly one of the best-flying ¼-scale airplanes we've ever flown.

- **Low-speed performance**
  This plane is very stable during low-speed flight. We spent a great deal of time inducing low-speed stalls (high up in the air), and we were impressed with the gentle stalls. The nose dropped off without either wing dipping. Recovery was virtually hands-off and nearly instant.

- **Aerobatics**
  The Spacewalker II's responsiveness allowed it to rip off snap rolls and Lomcevaks like a much smaller aircraft. Knife-edge flight was also surprisingly easy for such a large airplane. Its stability was clearly evident whenever we pulled out of a high-speed loop; there was no hint of wobbling or darting. Inverted flight was very gentle and required only the slightest of down-elevator. The airplane responded well while inverted. The ailerons were responsive in both low- and high-speed flight, and we didn't think it was necessary to use dual-rate controls.

BUILDING



Wing construction is straightforward, and the finished wings are very durable.

If you've ever built a Sig kit, you know that you can expect high-quality materials, exceptional instructions, accurate three-view drawings and an obvious enthusiasm for a well-tested product. The kit-supplied balsa, plywood and spruce were as close to perfect as we've come to expect, but we must say that we were particularly impressed with the high quality of the pre-formed ABS cowl, wingtips and wheel pants. There's no scrimping here in design or materials. Everything fits well and looks outstanding.

The building sequence starts with the wing, but as Sig intelligently points out in their construction manual, you don't have to follow the order exactly. You might want to go as far you can on the wing and then, while it dries, start on the fuselage. The wing halves are built separately and joined later. One of the first steps in building the wing involves using pieces of scrap balsa to join four of the sub-ribs that make up the inboard and outboard ends of each aileron. The photo doesn't clearly illustrate this, and we had to give it a second try after we had realized what was going on. Here's the skinny, so you won't make the same mistake: the two ribs are only joined temporarily with the piece of scrap, which you cut out later. This allows you to build the ailerons straight and true with the wing and then to separate them afterward. This is no big deal, but since we missed it, we thought that others might misinterpret this in the same way and that we could help to prevent that.

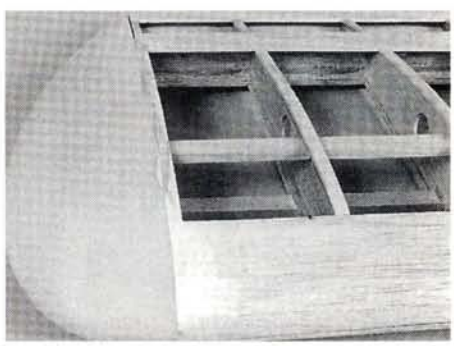
Wing construction doesn't have any unusual steps and moves along quickly for experienced builders. We should point out that we found the wing sheeting unacceptably warped, but at least the 3/32x1x42-inch piece was easily and cheaply replaced. The spar webs are made out of lite-ply and pre-cut balsa. Initially, spar webs aren't installed on the rear of the spars because you'll need room to get at the pins in the bottom spar when it's time to remove the wing from the building board. Curiously, we found that our kit was missing six spar webs.

The Webra 120 speed engine is a brute. Its torque packs a wallop. The power transition from idle to wide open is extremely smooth.

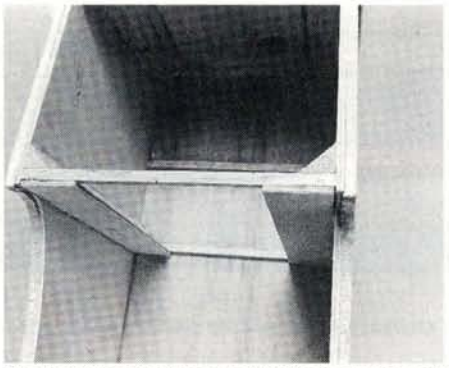
We absolutely loved the steps for gluing the ABS wingtip onto the wing, and we had no problem installing the dowels in the edge of the wing.

Hinging the control surfaces was fun because Sig thoughtfully supplies giant-scale pinned hinges that can be easily disassembled when it's time to cover the model. These hinges are easy to work with, and installation is simple. In the nit-picking column, we noted that our kit was missing one hinge.

The beautiful, intricate fuselage is, in reality, quite simple to construct. We found no problems during this part of the assembly and, in fact, enjoyed it quite a bit.



Left: a view of the underside shows the servo mounting. The kit calls for heavy-duty servos. Right: the ABS wingtips fit wonderfully and enhance the plane's appearance.



The box-type fuselage construction is simple and durable.

ENGINE

There are a couple of options for engine installation. An inverted mount is often used on this airplane so that the cylinder doesn't stick out the side of the cowl, as it does on a sideways mount. One point to keep in mind if you want to mount your engine sideways: you'll probably need to mount the fuel tank higher, and that requires cutting into the plywood top. Sig doesn't recommend that you do this.

We used a brand-new Webra* 120 speed engine with a 14x8 Rev-Up* prop to power the Spacewalker II. This is a powerful engine with extremely friendly starting habits. We'll get into its performance later.

FINISHING

We covered our model with Goldberg* Ultracote. We chose an alternative paint scheme, and, never ones to conform, we reversed the suggested color scheme. The Sig Spacewalker II makes a very handsome model and will surely attract the attention of anyone on the flight line—even before you taxi out to the runway.

AIR TIME

We set the surface movements exactly as Sig suggests, with ¾ inch up and down elevator, 1 inch left and right rudder, and 1 inch up and ¾ inch down for ailerons. These recommendations proved to be spot-on, and we never felt the need to change them.

The Spacewalker II is an exciting airplane to fly. We pointed it down the runway and, once it was up to speed, it jumped into the air and remained rock-solid after just a couple of extremely minor trim adjustments. We also felt that the recommended balance point was optimum for finding the best balance between docile handling and screaming stunt capabilities. The Spacewalker II definitely exhibits both qualities in the air. In fact, its slow-flight accuracy led us to surmise that advanced pilots might want to consider this craft for fun-fly contests, in which accuracy and realism of flight are key concerns. If you want to use a coupling system to coordinate turns using both the ailerons and the rudder, Sig recommends that you deflect the rudder about ½ inch in each direction for full deflection of the ailerons.

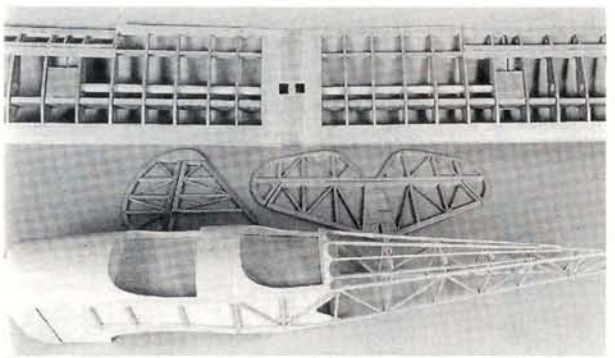
We used Satellite City glues throughout the construction, and we found them excellent.*

Some tips on takeoff? None are needed. Sure, it's a tail-dragger, and a 120 engine will produce a bunch of torque, but the Spacewalker II has never let the bad habits of a sloppy pilot become exaggerated on the runway. With careful attention to the sticks, you can achieve arrow-straight roll-outs. This airplane makes you think that you're a pretty darn good pilot as you rip straight down the center line and peel off into the sky. We did it time and time again, and we've definitely struggled with other tail-draggers in the past. This stability is certainly a product of the long tail moment incorporated into the Spacewalker II's design.

Landing is just as easy. Although we firmly believe that you can approach the runway with any style that suits you (hot and low, high and slow, chopped and ready to go, etc.), we prefer to drop the throttle down to idle when we're certain that the craft has enough air speed to make it back to the edge of the runway. Then we guide it in on a shallow path, because the airplane just wants to keep on flying, and we don't want it to end up 50 yards away by the time it touches the tarmac. There's no doubt that a great deal of the credit for this rock-solid feel and generous amount of lift goes to the thick airfoil.

The takeoffs and landings are stellar, but you can't really appreciate the nature of the Spacewalker II in flight just by reading about it. If you're considering this kit as your next project but you need a little more prodding, find someone with a Spacewalker II, and

(Continued on page 108)



Although its scale appearance might intimidate novice builders, there's nothing difficult in the Spacewalker II's building.

SPECIFICATIONS

Model name: Spacewalker II
Manufacturer: Sig Mfg. Co.
Type: ¼ scale
Sug. price: $209.95
Wingspan: 84 in.
Wing area: 1,110 sq. in.
Wing loading: 24.93 oz. per sq. ft. (at 12 lbs.)
Weight: 11 to 13 lbs.
Length: 60½ inches
No. of channels req'd: 4 (rudder, elevator, aileron, throttle)
Power req'd: .90 to 1.20 2-stroke; 1.20 to 1.60 4-stroke
Engine used: Webra 1.20 speed 2-stroke
Prop used: Rev-Up 14x8
Airfoil type: Semi-symmetrical
Wing construction: Spruce spar and built-up balsa
Kit construction: Built-up ply and balsa; ABS wingtips
Washout: No

Features: balsa-and-ply kit comes with ABS wingtips, folded plans and a 23-page construction manual with photos and illustrations. Pushrods, bellcranks, landing gear, dummy engine cylinders and a cowl are supplied. The tank and wheels aren't included.

Hits
- Extremely good habits during low-speed flight
- Easy to build with high-quality components
- Kit includes three-view drawings
- With wing installed, airplane fits in pick-up bed
- Highly maneuverable

Misses
- A few small parts were left out of the kit.
- This author thought that the manual could use additional drawings or photos to clarify the assembly of aileron end ribs.

HOW TO

Reducing ENGINE NOISE Part 2

by DENNY ATKINS & RAY ABADIE

Co-author Denny Atkins poses with the test aircraft that's equipped with the Hobby Lobby extension muffler.

IS LOADING THE ENGINE AN ANSWER?

Editor's note: in Part 1, the authors provided a brief overview of the challenges posed by model-engine noise (including a discussion of the danger of hearing loss from excessive model-engine sound levels), and they presented initial findings based on trial tests of off-the-shelf components. These components included iso-mounts and various mufflers and after-mufflers. In Part 2, the authors continue their analysis by describing the effects of loading the engine with a large propeller. They also provide a useful "laundry list" of starting points for quieting your model.

The authors' propeller recommendations effectively trade horizontal flight speed for significant reductions in sound levels, enhanced vertical performance and shorter takeoff runs. This is a non-traditional approach and is not relevant to high-rpm applications. We applaud the authors for their efforts to explore practical solutions to the problem of excessive engine noise. Their findings are not intended to be the ultimate solution and will be viewed by many as controversial. But these findings are thought-provoking and, we think, useful.

We believe that it is important to make available to modelers a base line of practical sound-reduction techniques. This two-part series is only a start in that effort; we seek more such material for publication. Do you have practical insights—and success stories—on sound-reduction techniques that you can share with our readers ? Do you feel that manufacturers should offer a variety of purpose-designed, "quiet" engines? Write to us at 251 Danbury Rd,. Wilton, CT 06897, and let us know. And remember: quiet is cool.

SHORTLY after the release of "Model Engines, Volume 1"* (reviewed in the March '93 issue of *Model Airplane News*), we decided to conduct more tests to determine how quiet we could make our Sig* Four-Star 40 without hurting its flying characteristics. We used the same O.S.* .46 SF ABC engine with its stock muffler mounted on the Sullivan* soft mounts.

Since we had seen that after-mufflers were capable of some sound reduction, we searched for one with a large volume chamber to continue our tests. We found what we were looking for in the Hobby Lobby International* catalogue. These after-mufflers come in five sizes from 3 inches long to 12 inches long. All are 1.25 inches in diameter. Wanting the maximum sound reduction, we chose the largest. It was attached to the outlet of the stock muffler with a ½-inch-i.d. silicone hose that was 3 inches long. It was supported on the side of the fuselage with a standard tuned-pipe support. *[Editor's note: Soundmaster extension mufflers are also available from Davis Diesel.*]*

Keeping the previous 11x6 rounded-tip wood prop, the engine was started at idle speed. Huh, where's the noise?!! The engine was so quiet at 3,000rpm, it was unbelievable! The dB meter read 62 at 9 feet at idle speed. Our hopes where running pretty high, so we opened the throttle fully and reached 11,600rpm. Unfortunately, the dB meter read 89.

While the engine was running at 11,600rpm, we added another after-muffler to the outlet of the first one. No change in rpm or dB level could be detected! Very interesting! From this we could draw the conclusion that the exhaust had been muffled enough for another source to be identifed as the dominant source of noise. The next suspect was prop noise.

We had seen the significant reduction in sound level that occurred at idle speed with

PROPELLER PERFORMANCE RESULTS				
DIAMETER	PITCH	RPM	STATIC THRUST	dB
10	6	13,500	63	92
10	7	12,500	64	91
11	6	11,600	67	89
12	6	10,600	68	87
12	8	8,400	59	82
12	9	7,500	44	81
13	5	8,000	71	83

the use of this after-muffler. Once again, the inescapable conclusion was that rpm needed to drop in order to attack the sound level, which was now suspected to be primarily from the prop.

The rpm reduction could be accomplished by using a larger-diameter prop or a higher-pitch prop, or a combination of both. The task we faced was to devise a method to determine the correct prop size to achieve a reasonable compromise between sound reduction and performance.

In order to gather some data, we tested the Four-Star 40 with wood propellers of several sizes. All were carefully balanced and had rounded tips. As a basis for performance comparison, we chose to measure static thrust. The results we obtained are shown in the chart.

As we examined the results, we found that, as expected, as rpm dropped, the sound levels were reduced substantially. We also confirmed the rule that increasing diameter instead of pitch increases static thrust. *[Editor's note: for any given propeller diameter, as the pitch is reduced, the static thrust will increase. On the other hand, increasing pitch in relation to diameter will, up to a point, increase horizontal flight speed at the expense of static thrust. Hence, if horizontal speed is your goal, static thrust can be a poor indicator of airborne performance.]*

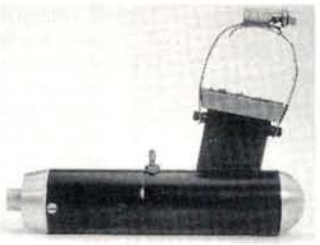
REACHING SAFE SOUND LEVELS

The results seemed to clearly show that all of the sound-reduction devices and techniques can help, but that truly safe sound levels can be achieved only when we reduce rpm. A generalized rule was needed to provide a starting point at which to test large props for an engine of any size. After more research and tests, we found a developing pattern that gave us some general-purpose guidelines.

The magic formula we arrived at is to exploit *torque!* That's correct; prop the engine to run within its maximum torque rpm range. Remember, torque is the twisting force that the engine develops. Maximum torque is developed at an rpm range that's well below that of maximum horsepower. *[Editor's note: engine reviewers have advocated running engines within the "torque band" for years, and this has included the advantage of heavily propping large, slow-flying models. To our knowledge, however, exploiting this purely for the sake of reducing sound has not been extensively investigated.]*

The problem is determining what the maximum torque rpm for a particular engine is. Most manufacturers do not state this information. While researching engine reviews that presented torque information, we consistently saw that the maximum torque seems to occur at about 45 percent below maximum horsepower rpm. For example, the O.S. .46 SF ABC is rated at its maximum horsepower at 16,000rpm. So, deducting 45 percent of this rpm, the maximum torque should be developed at 8,800rpm.

At this rpm, the engine cannot develop its maximum possible horsepower, but the larger prop operating in the maximum torque range helps offset that. If more power is needed, you can switch to a larger engine and again prop it for maximum torque. Indeed, that is what we effectively did on the Four Star 40, as this light airplane could be easily flown on a .25-size engine.



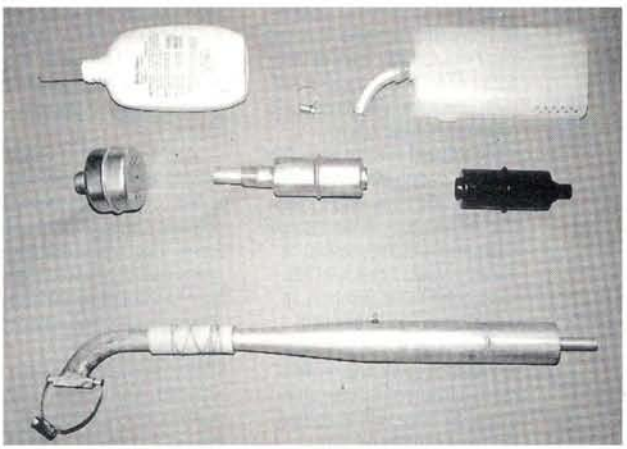
The SM-2 Soundmaster muffler from Davis Diesel was tested in Part 1 of this article. Its effectiveness (and that of other quiet mufflers) increases dramatically as rpm is reduced.

RUN IT RICH

The techniques described here are meant to be employed carefully. Always be sure to operate your over-propped engine a little rich. The additional cooling provided by a rich mixture will help overcome (1) the increased heat generated and (2) the loss of cooling air owing to the slower-rotating prop. Another important thing to consider is the composition of your fuel. The potential for heat damage is increased when the engine is operated in the manner we have recommended. It is of great importance that your fuel be a top quality blend containing at least 20 percent oil with a significant portion being castor oil (castor's lubricity is unsurpassed in high-heat applications).

[Editor's note: what is the advisable upper limit of propeller size for a given engine? The answer to this question requires empirical testing of actual engines and props. Knowing that the conventional wisdom is geared toward higher rpm, we nonetheless sought the advice of some "experts" to shed additional light.

Bob Davis of Davis Diesel points out that a glow engine is a type of diesel and, as such, is a "load-critical" device. Its timing is fixed and the functioning of the engine is very sensitive to changes in load. Bob, invoking a widely accepted rule of thumb as a starting point in the analysis, suggests that if you prop an engine at 80 percent of its manufacturer-recommended, peak-horsepower rpm, you will optimize performance and longevity. This admittedly conservative approach will keep you clear of load-related temperature swings. Such swings can cause a temperature-induced timing change that, for example, could cause an engine to lean out and die when going vertical. These thermal swings are related to ambient conditions and changing work loads and, if your engine is overloaded, can occur without warning. But is the traditional 80-percent rule of thumb too conservative? Bob suggested we ask those who have experimented.



In Part 1 of the series, these components were tested for their ability to quiet engine noise. Clockwise from top left: hand-lotion bottle with holes, fuel tank with holes, J-Tec* Snuffler, MAC's* Quiet Pipe, and lawnmower muffler no. 2. Center: lawnmower muffler no. 1.

David Gierke, who has been pioneering in-flight engine testing for "Model Airplane News," has flight-tested several engines with large props. Dave observes that as long as you are on the rich side of your needle setting and at least half of your lubricant is castor, engines that have been loaded down with large props run well at rpm as low as 8,000. This agrees squarely with the authors' findings.

What precautions should be taken when experimenting with larger props? Bob Davis suggests that you use lots of oil in your fuel and, to reduce timing, jack up the head by inserting a couple of additional head gaskets. This lowers the compression and retards the timing slightly so that the firing occurs later. This helps reduce heat and noise. Bob notes that if the engine does seriously overheat, synthetic oil will burn up and the engine may seize or be damaged. Using lots of castor is the best insurance.

Pattern fliers are noted for quieting their ships by adding propeller load. "Aerobatics Made Easy" columnist and world-class pattern competitor David Patrick offers the following observations: if you are going to experiment with adding propeller load, use an ABC engine because the parts will expand and loosen as heat increases. Before you load an engine down, it must be well broken-in. You must run the engine rich if you are going to load it down. Dave agrees with Bob that shimming the head can help, but he adds that the addition of nitro can add power that will help the engine turn a bigger prop. (Interestingly, nitro can cut both ways on the sound-reduction front. Bob Davis notes that nitro "broadens the needle range" and can boost efficiency of the fuel burn in a fuel-rich environment. On the other hand, David Baron, after testing the effect of nitro content on noise and rpm, reported on page 81 in our March 1992 issue that there is an average 1dB increment in sound level for every 5 percent of nitro added to glow fuel. This, of course, was in a high-rpm context, not in the low-rpm setting at issue here.)

Dave Patrick notes that if there is too much prop on your engine, it will be hard to throttle and start to sag, and if the prop is too large, it will cause a potentially damaging heat buildup. Again, how far you can go with a particular engine requires empirical testing. (You have to find out for yourself!) Dave has promised to offer more detail in an upcoming "Aerobatics Made Easy" column.]

A larger engine operated in this fashion will produce a lower sound level for a variety of reasons. At lower rpm, the mixture in the combustion chamber has more time to burn and, thus, exits the exhaust cooler. Lower rpm means a lower frequency and a slower sound-pressure wave, and this produces less annoying sound. It also means less venturi and propeller sound. This is certainly one example of less is better!

FLIGHT TESTS

The acid test came when we took the Four Star 40 to the field and flew it with the stock muffler, a Hobby Lobby after-muffler, a Sullivan soft mount and a 13x5 wood prop with rounded tips. We chose this prop as a reasonable compromise of power versus sound reduction that would place the engine rpm in its maximum torque range. The airplane exhibited incredible vertical performance and a sound level so low that few of those present could believe it! High speed was decreased somewhat, but the trade-off was well worth it!

CONCLUSION

The measures discussed in this article will contribute greatly to reducing sound levels

QUIET FROM THE GROUND UP

It has become increasingly apparent that ultimate sound reduction must be an undertaking from the very beginning of planning and construction. In retrospect, we realize there is no magic device that will substantially reduce the sound levels unless you "build in quiet" at every step of the game and are willing to reduce engine rpm.

Here are some things to keep in mind; they can quiet your airplane down:

- Some materials are good sound conductors and others are insulators. Using less of the former and more of the latter will contribute to making an airframe that's less likely to become a resonating chamber that adds to the overall sound problem. Conductors include fiberglass, plywood and plastic covering over open areas. Insulators include balsa, foam and rubber. For example, you can replace plywood fuselage sides with balsa, skin open wing bays with balsa or, better yet, you can use foam wings. Also, consider adding soft-balsa corner blocks to former junctions, and install them around the tank compartment to act as dampers. Closely fitted wheels with heavy grease packing will prevent rattling vibration at this often overlooked source.
- The exhaust system should be planned during the construction stage. Many of the more effective devices have large-volume chambers and will require, at the very least, a sturdy attachment point to the fuselage. In some cases, the expansion chamber can be built into the airframe or cowl. A very effective combination involves the use of an after-muffler behind the stock muffler. In some cases, mostly when the after-muffler is of a tubular design, they actually contribute to engine power output by aiding the scavenging of the cylinder during the exhaust phase. *[Editor's note: Bob Davis sells a flexible tube that is said to increase performance when attached to the Davis Soundmaster muffler.]* The additional power is best put to use by increasing propeller size rather than allowing engine rpm to increase.
- When purchasing an engine, consider that horsepower is a function of torque and rpm. An engine can be designed to deliver a rated horsepower by either the high rpm/low torque (e.g., 3hp ducted-fan engine), or the high torque/low rpm (e.g., 3hp lawn mower engine) approach.

The most significant reductions in sound levels occur when we trade rpm for torque. More torque will allow a larger prop to be turned at a lower rpm yet deliver the same, or greater, static thrust.

One design feature that trades rpm for torque is a long stroke. Few long-stroke engines are currently available. Two examples are the O.S. .61 and the Webra* .61 LS. We hope the demand for quieter engines will drive the introduction of a greater variety in the near future.

Another breed of engines, diesels are particularly well-suited to delivering their power at lower rpm and lower sound levels. This is possible because of the burning characteristics of their fuel and their variable compression ratio. They are definitely worth looking at.

- Once an engine has been selected, you should seriously consider the use of a soft-mount system. By isolating vibration, you diminish the possibility of airframe "drumming." Once you have decided on a system, you will have to plan, and possibly strengthen, the firewall to accommodate the increased "shake" these mounts allow at low rpm. This should also be taken into consideration when cutting cowls, as additional clearance will be needed.
- Take a hint from the padded engine compartments used by automakers to reduce sound. When possible, use a full cowl with some insulating material (such as balsa or foam) on the inside. Plan sufficient cooling air flow (both in and out) to prevent your engine from overheating.
- The next item worth considering is the choice and preparation of the prop. In order to reduce rpm, you will have to choose your prop wisely and be willing to experiment a little. Start by determining whether you wish to load the engine by increasing diameter (preferred) or pitch, or both. Take into consideration the type of airplane and amount of ground clearance required. Simple details, such as balancing a prop, can contribute to the overall sound picture. We have consistently observed that wood props with rounded tips produce less noise than wood props with squared-off tips.
- An air-intake filter with a foam membrane can reduce an often overlooked source of sound—the venturi. Unfortunately, few such filters are currently available so some improvisation is in order. *[Editor's note: Bru-Line* produces air cleaners that fit over the venturi of model engines. Bru Line reports that no testing has been done to determine if quieting results. Readers who wish to experiment on this front will at least know their engines will be kept cleaner!]*

We see this time as a great opportunity for both engine manufacturers and others to develop the products we truly need: more long-stroke engines, suitable air-cleaner/venturi mufflers, quieter props and even more effective mufflers.

and meeting or exceeding the AMA proposed limit of 90dB at 9 feet. Lower levels for the sake of flying-field preservation and personal safety are necessary. We encourage you to experiment and keep us informed of any progress you make. Write to us, care of *Model Airplane News*.

We see this time as a great opportunity for both engine manufacturers and others to develop the products we truly need: more long-stroke engines, suitable air-cleaner/venturi mufflers, quieter props and even more effective mufflers. Modelers with an interest in quieter systems should contact their favorite manufacturers and let them know the need is real. Tell them that the historic perception that rpm is the only way to achieve power and suitable flight performance is quickly fading. They will listen!

[Editor's note: it is commendable that the authors have found success with their specific combination of components and strategies. We hope this inspires many among our readers to experiment with these solutions. This can save flying fields.

We hope this will inspire modelers to look for solutions in other areas of our sport as well, including high-performance, high-rpm areas. Bob Violett of BVM has been a leader in the field of high-performance noise reduction with his Jet Silencer tuned-pipe-system for ducted fans and recently developed Hush Kit noise-reduction treatment for the inlet. In future articles, we will report on these developments as well.]*

**Here are the addresses that are pertinent to this article:*
Model Engines, Volume 1, *Hobby Supply South, 5060 Glade Rd., Acworth, GA 30101.*
Sig Mfg., *401 S. Front St., Montezuma, IA 50171.*
O.S; *distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826.*
Sullivan Products, *P.O. Box 5166, Baltimore, MD 21224.*
Hobby Lobby International, *5614 Franklin Pike Cir., Brentwood, TN 37027.*
Davis Diesel Development Inc., *P.O. Box 141, Milford, CT 06460.*
Bob Violett Models, *170 State Rd. 419, Winter Springs, FL 32708.*
Webra; *distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*
Bru-Line Industries Inc., *P.O. Box 3786, Center Line, MI 48015.*
J'Tec, *164 School St., Daly City, CA 94014.*
MAC's, *7935A Carlton Rd., Sacramento, CA 95826.* ■

The Dragonfly comes out on top

Understanding The ½ A Throttle

by LARRY RENGER

Editor's note: in the June '93 issue of "Model Airplane News," Randy Randolph's "How To" column described a hop-up for the Cox Black Widow engine. After a careful read, Larry Renger, director of engineering at Cox Hobbies, called to let us know that there was more to the story, including some interesting differences between the Cox Black Widow, Tee Dee, Medallion, Dragonfly and "product" engines. We agreed with Larry, and think you will, too. This article is the result.*

The Dragonfly .049 features a throttle/muffler installed and a fuel tank with a clunk for inverted flight. A complete R/C package.

THE REST OF THE STORY

In the June issue of *Model Airplane News*, Randy Randolph published a brief article on modifying the Cox Black Widow engine. I would like to offer corrections for a couple of items and some explanations and ideas.

First, he is running the engine on 10-percent-nitro fuel. Cox recommends that fuel be at least 15 percent nitro and 20 percent castor oil. The high speeds and small sizes of these engines require it. [*Editor's note: Randy runs 20 percent lubricant that is a castor/synthetic mixture. Larry said this would probably be OK as long as the castor is of high grade.*]

Second, the Black Widow engine does not have the same cylinder and piston as the Tee Dee series. The bypass porting is different, and the tapers ground into the piston and cylinder to compensate for thermal expansion are not as radical. The Black Widow bypasses are dual-port, but they are simple cylindrical cuts in the cylinder wall. The Tee Dee has six cuts instead of two. (See Figure 2 for the side view and cross-sections.) This additional work does two things: first, it provides more area for fuel/air mixture flow and, second, it makes the top of the port more square so it opens and shuts more quickly.

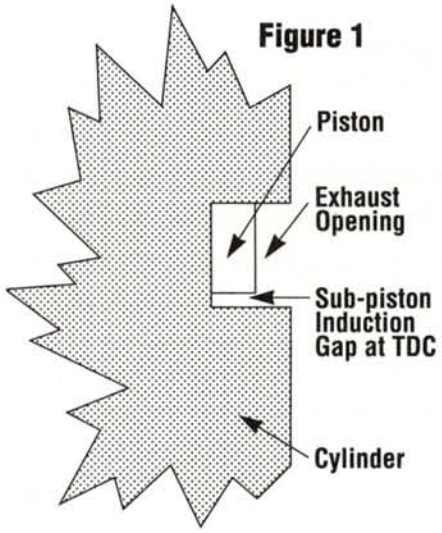
A feature shared by both engines is called "sub-piston induction." This is done by having the exhaust opening deep enough for the bottom of the piston to clear it at the top of the stroke (Figure 1). There are a couple of theories why this helps an engine, but the key is that it is good for a serious rpm boost under the right circumstances. It is also good for a serious rpm loss under the wrong circumstances. Randy's modification is of the second type.

When you have any exhaust restriction, such as is provided by a muffler or an exhaust-restricting throttle, the exhaust is forced back through the sub-piston opening and dilutes the fresh mixture. This technique is pretty much how the Maples Throttle works on Cox R/C race cars. So an engine like the Black Widow, which should turn around 15,000rpm, suffers major rpm loss with the addition of a throttle. Randy has tried to make up the difference by freeing up the airflow at the venturi. (Modifications always void your warranty, by the way.) The good news is he got some rpm back; the bad news is that without the screen, any dirt, grass seeds, etc., can get under the reed valve and require an engine tear down to clear up.

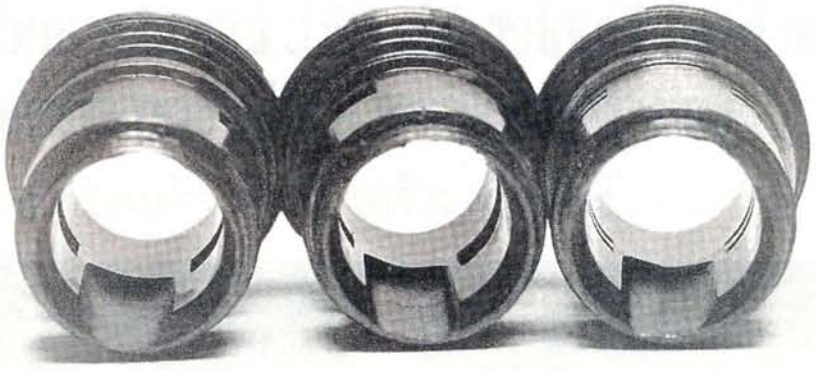
So what should have been done? If you are going to use an exhaust throttle, at a minimum, replace the cylinder on the Black

PHOTOS BY LARRY RENGER

Figure 1



The Dragonfly has been available for nearly five years, but its existence seems to be a well-kept secret.



Above: the porting differences between the Black Widow, Tee Dee and Dragonfly/Medallion may appear subtle on quick inspection, but they are actually quite different in terms of shape and area.

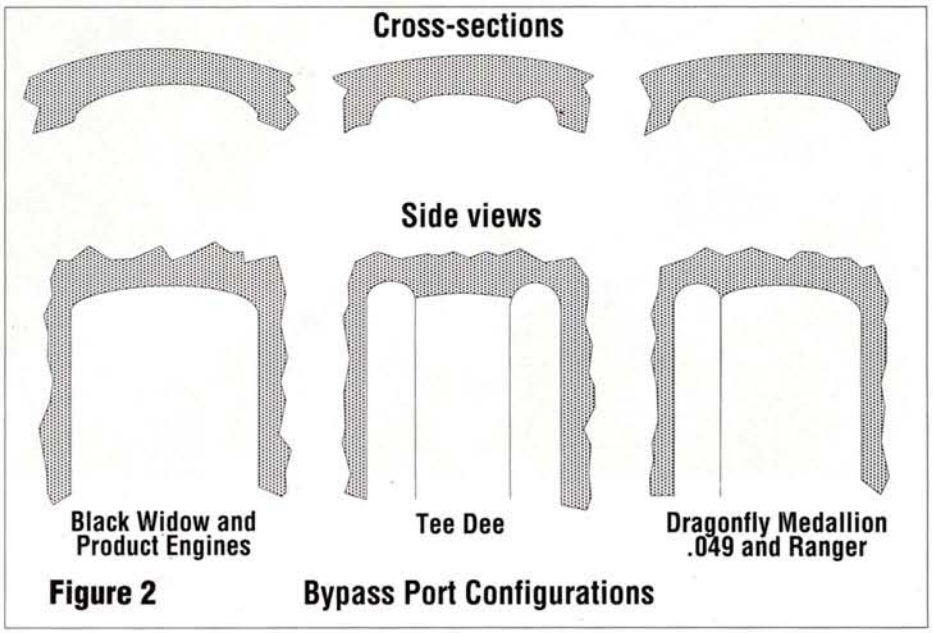


Figure 2 **Bypass Port Configurations**

Widow with one of the cylinders from Cox's "product" engines, i.e., an engine from a Cox ready-to-fly airplane. That would at least get rid of the sub-piston induction. The bypass porting is the same as on the Black Widow. At that point, you might get some further rpm back with Randy's modification. Better still, get the cylinder, piston, and throttle/muffler from either a Medallion .049 or the Dragonfly .049.

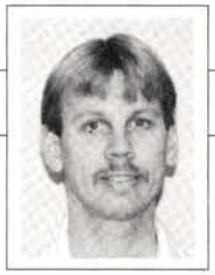
By the time you buy the spare parts, usually at full price, it is probably cheaper to get an entire Dragonfly engine through one of the discount houses. The Dragonfly .049 features a throttle/muffler already installed, and has a fuel tank of about half again the Black Widow's capacity. In addition, the tank has a built-in clunk for inverted flight. You certainly aren't going to get that feature with the Black Widow. The Dragonfly is sort of a complete R/C power package in a box—no extra tank to buy, install and plumb; quiet running and great throttle response. What else could you need?

Cox's QC test records show an average of 14,500rpm for this engine, with the muffler closed, on 15-percent-nitro fuel and the gray (competition) 6x3 prop. The best examples will get up to 16,000. The cylinder on the Dragonfly is different from those on the Tee Dee and Black Widow and "product" engines. It has the thin-slit exhaust ports and twin bypasses with one extra flute cut in each bypass—sort of half a Tee Dee. This gives enough extra punch over the Black Widow bypasses to get the rpm back up despite the muffler. Also, of course, the exhaust ports have no sub-piston induction.

The Dragonfly has been available for nearly five years, but its existence seems to be a well-kept secret. Happily, over the next year, you will be seeing designs and kits that utilize its full capabilities.

**Here's the address of the company featured in this article:*
***Cox Hobbies**, 350 W. Rincon St., Corona, CA 91720.* ■

CENTER ON LIFT



MICHAEL LACHOWSKI

ENLIGHTENING BUILDING TECHNIQUES

This is my hand-launch glider design. The stripe along the length of the wing is carbon fiber.

SAVING WEIGHT IS important for hand-launch glider (HLG) builders. This month, I'll discuss some experiments I've conducted to save weight when laying up HLG wings. I'll also review CST's* composite workshop video tape. It's a good introduction for builders who don't know much about composite building and are still building with balsa. And for those who prefer kits, I have some information on the Monarch. This kit includes some interesting innovations that shed light on how to build a good HLG.

COMPOSITE HLG WING CONSTRUCTION

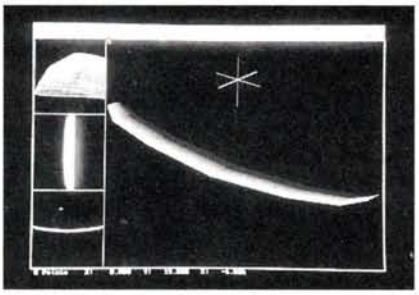
Before getting into the construction details, let's discuss the model that led me to experiment with two approaches to very light wings. It was two weeks before the next contest, and I didn't have anything suitable to fly. It was time to start building.

The first step was to get a fuselage. I picked up one from Terry Luckenbach*, who had recently completed a mold for a new HLG fuselage. (Terry sells high-quality fuses for thermal planes as well.) It has plenty of room up front, and the fuselage can accept wing chords of many different sizes. Wing position can be adjusted so that you won't have to add weight to balance the model. At 2.3 ounces, the fuselage wasn't the lightest possible, but I could work with it.

WING DESIGN

The model's wingspan was planned to be 1.5 meters, and I would use an E387 airfoil. This airfoil has proven to be a good HLG selection on designs like the Vertigo. To design the wing planform, I used DesignCAD 3D*. This software enabled me to try different wing planforms until I found one that looked good. I have some BasicCAD (part of DesignCAD) programs to quickly enter the wing geometry and read in airfoil files, so it's easy to try out a variety of layouts.

After assigning colors, DesignCAD 3D rendered a good image of the wing.



This CAD drawing of an HLG wing was made using DesignCAD 3D. The program permits you to shade a "wire frame" drawing.

(If you're interested in seeing more on software of this kind in this column, write to me c/o *Model Airplane News*.) My final design was a 385-square-inch, triple-taper, polyhedral wing with upswept tips.

Now let's discuss construction. My first wing was made out of blue Styrofoam. I cut the core using a FeatherCut* foam cutter and used laser-cut templates from Lee Murray*. No leading edge material or spars were used. The core weighed almost 3 ounces. The foam was pretty strong, so I covered it with one layer of 1.4-ounce fiberglass cloth. For a 385-square-inch wing, I needed almost ⅔ square yard of glass for the surface.

A good way to conservatively estimate the weight the epoxy will add in a fiberglass/epoxy lay-up is to double the weight of the fiberglass. This means that the completed skin would weigh just under 2 ounces. Adding weight for the dihedral joints and wing hold-down would bring the weight of the wing to just over 5 ounces.

After completing the wing, I decided the center section was not stiff enough, so I attached a 2-inch-wide strip of 1.4-ounce cloth, spanwise, between the first polyhedral breaks. The strip runs along the high point. This increased wing weight to 5¾ ounces. It's strong enough to take a launch on an upstart, i.e., a small high start.

PRODUCING GOOD TRAILING AND LEADING EDGES

The thin lay-up on a small HLG wing presents a problem at the trailing edge because the glass is very thin. I find that brushing some microballoons into the fabric at the trailing edge makes it stiffer and harder. *[Editor's note: sanding of microballoons, or fiberglass or carbon-fiber cloth, releases small fragments of glass, i.e., glass dust, into the air. Do not inhale this dust. Moreover, contact with epoxy resins, or inhalation of resin fumes, can, over time, cause sensitivity, and should be avoided. Always wear a cartridge respirator and latex gloves when handling epoxy, and use a high-quality filtered breathing mask or respirator when sanding these materials.]* Microballoons are light, microscopic glass balls that are much harder than epoxy. They fill the weave of the cloth and blend into the edge of the foam nicely. Of course, having a good core is just as important.

I cut the leading-edge shape into the foam. If you want to use this technique, tack on two strips of 1.4-ounce fiberglass, one on top of the other, with 3M77 spray before doing the bagging *[Editor's*

note, use a respirator when using spray adhesives; the compounds in most are harmful if inhaled]. The first strip is 1 inch wide and will cover the leading edge for the full span of the wing. Fold it over the leading edge so that ½ inch runs along the upper wing surface, and ½ inch along the lower surface.

Next, attach a second strip, ½ inch wide, along the leading edge so that ¼ inch folds over the top and bottom surfaces. This strip gives you something to sand when you do the final smoothing of the leading edge. Now use a little thin UFO* right at the edge of the leading edge. This hardens the leading edge and prevents these strips from slipping during the bagging process. It also provides a hard surface to sand before the epoxy has finished curing.

For those of you who may be unfamiliar with laminating epoxy, the epoxy cures sufficiently in 24 hours for you to remove the Mylar and work on the wing. It really takes several more days to reach final hardness. Trimming is easier when done during this curing period.

Two other things can be done to make shaping the leading edge easy.

• Cut the Mylar with scissors. The Mylar should not quite reach the leading edge when folded over the trailing edge of the wing core. Cutting with a knife distorts the edge of the Mylar, and that edge can then dig into the wing near the leading edge during the bagging process. This distortion isn't as bad when the Mylar is cut with scissors, and you won't have a depression in the wing to fill.

• Next, use Teflon-coated glass cloth or peel ply to overlay the Mylar and leading edge. This layer should extend beyond the wing's leading edge. I tape a narrow strip of Teflon-coated glass cloth to the outside of the Mylar. Because glass cloth has a coarser weave and is stiffer than peel ply, it leaves a little more epoxy on the outside of the leading edge. Its stiffness helps when handling the wet lay-up and placing the core in the vacuum bag.

When the wing comes out of the vacuum bag and you peel off the Mylar and the Teflon-coated glass cloth, you'll have a ridge of epoxy where the Mylar ended. Here's a technique that will help you to avoid the problem of sanding through to the foam when you have a very light lay-up. Use a sharp razor, at 90 degrees to the wing, to scrape this ridge (in a shaving motion) and remove most of the excess epoxy. Trim the flashing off the leading edge, and then finish sanding down the extra epoxy that remains from the weave of the Teflon-coated glass cloth.

Using this technique, I have produced some nicely shaped leading edges. After all, why should you use a strip of plastic tape to cover a lousy leading edge, or have to worry about adding filler?

I bagged the entire wing flat, in one piece. Bagging the wing in one piece means all the panels will fit smoothly when you make the dihedral and polyhedral joints. My wing has six separate panels that, before bagging, were tacked

MONARCH HAND-LAUNCH GLIDER

Russell Bennett and his Monarch, with which he placed first at the 6th Annual SKSS Spring Fling.

Available from Northeast Sailplane Products*, the DJ Aerotech Monarch is an interesting, new, hand-launch design. It has a thin airfoil, and it weighs only 10½ to 11 ounces. The flat fuselage is unique; all the equipment, including the servos, lies flat in it. This design permits a reduced fuselage surface area, especially under the wing, and its shape makes it easy to set up for a two-finger grip. The photo shows the finger-hole cut under the wing; the fiberglass/Kevlar is pushed in when you launch. When airborne, this flap springs back.

The thin tubes for the pushrod wires are molded into the inside wall of the fuselage along its full length; they strengthen the fuse without increasing its weight.

The wing and stab fairings are also molded into the fuselage; this makes it easy to align the vee-tail, and it also provides a good gluing area.

The white-foam wing has a 1/32-inch-thick-balsa skin, so it's very light. I have no specific details on the airfoil design, but it looks like a thin SD7037. A light model with a thin, reasonably cambered airfoil has a wide speed range and the capability to slow down in flight.

The Monarch's radio equipment is all mounted flat. The end of the pushrod tube that's molded into the fuselage is just in front of the wing. Russell uses an Airtronics* Vision transmitter, Airtronics 501 servos and an RCD* 5-channel receiver.

Push in a small hatch on the bottom of the Monarch's fuselage, and you have a convenient finger-hole. Notice the shallowness of the fuselage under the wing.

together (with spray adhesive) at what would eventually become the root and polyhedral joints. After bagging, the facing panel edges were beveled to allow for dihedral and polyhedral, and the panels permanently joined. I should also note I added some extra fiberglass cloth in the wing-saddle area to prevent damage to the thin wing skin near the hold-down bolt.

I WANT A LIGHTER WING!

The model weighs 13¼ ounces. I tried something else to reduce weight—a wing made of pink, Foamular 150 foam. Like the blue foam, this is also an extruded polystyrene, but it has a lower density, so the core weighs only around 2 ounces.

But this foam does not have the compressive strength of the blue foam, and it's easily crushed. The thin skin on the pink foam is a problem, too. If you grab the wing too hard, you'll dent its surface. Adding glass cloth adds weight, and I wanted to avoid this.

This time, I used a layer of 1.4-ounce glass and a second layer of .75-ounce glass. For stiffness, before I bagged the wing, I attached a 3/16-wide strip of .003 carbon fiber to the upper surface of the foam wing with thick UFO. This strip is run along the entire span at the thickest part of the wing. Everything else was built the same. The result was a 4½-ounce wing. But it failed on a hard launch!

Pink foam is easily crushed, and the very thin carbon does not resist buckling, so the wing failed 2 inches from the center section on the top skin. I repaired a wing following a method all the balsa builders will be proud of. I routed out a ⅛ slot on the top and put in a hard balsa spar. Now I have a 4¾-ounce, repaired wing and a 12½-ounce model. I still have the full case on the receiver

(Continued on page 115)

PRODUCT REVIEW

Astro Flight 110XL DC Peak Detector Battery Charger

4- to 16-cell workhorse

by TOM ATWOOD

ELECTRIC FLIGHT is an area of the sport in which I have more than a passing interest. My own experience with Astro Flight* chargers (and I have used a wide variety of chargers over the last few years) dovetails with the anecdotal accounts I have heard at the flying field.

Astro chargers seem to do as consistently good a job of packing in the juice and avoiding false peaks as any of the top chargers on the market, but they aren't priced at the top end. They are also rugged, simple pieces of machinery—kind of like the "Jeep" model among chargers. They don't offer a lot of bells and whistles, but they do the job well.

The 110XL is one of two new chargers Astro has brought to market in the last year (the other, the Model 112PK, handles four to 36 cells). The 110XL will automatically fast-charge Ni-Cd battery packs containing from four to 16 cells. The cells can have a capacity of from 250 to 4000mAh. The charger has an analogue DC ammeter and a current-regulating dial so that you can vary the charge rate from around .5 amp to 5 amps. The response of the ammeter to dialed-in changes in charge rate is immediate and solid.

The 110XL features a built-in 1½-inch fan that draws cooling air through the case. The fan immediately kicks in when the power input leads are connected to a 12V to 16V power source. You can use an auto battery (with or without a running engine) or a standard 12V gell-cell battery. A 12V hobby power supply, or a standard 12V, 10-amp auto-battery charger will also work well. There is no need to turn the unit on; you connect the power leads, then connect the battery and then press the start button. Then dial-up the charge rate desired, and just wait until the battery is peak-charged. After the charge, the charger switches to the 100mAh "trickle" mode and maintains it until the cells have been disconnected.

Astro Flight's new model 110XL charger automatically peak-charges from four to 16 cells.

Note that the charger pulls about 1 amp from the power supply for every six cells that are charged an amp. Hence, when charging six cells at a rate of 5 amps, 5 amps are required from the power supply. Charging 12 cells at 5 amps would require 10 amps, and charging 16 cells, 12.5 amps. If your power supply or battery can only offer 10 amps of current, you would want to charge a 16-cell pack at a 4A charge. (There are 2.5 "6-cell" units in a 16-cell pack, and 2.5 x 4 = 10—the number of amps the power supply can offer).

The system contains capacitors that enable it to receive power from unfiltered power supplies such as an auto-battery charger. This has a side effect: the leads spark when you first attach them to, for example, an auto battery. If your car has an old battery with vented caps, attach one lead to the positive battery terminal and the other to the chassis, away from the battery (such batteries vent hydrogen).

VERSATILITY

When I first received the charger, I pulled out a 16-cell pack of Trinity* Pushed Sanyo 1400mAh SCRs (for a Hobby Lobby Sunfly I recently purchased secondhand), and a 4-cell 600mAh Sanyo receiver pack. I fast-charged the 16-cell pack at a 5A rate, and the 600mAh pack at a 1.5A rate. Both packs were peak-charged without a hitch.

When the unit peaks, the voltage will drop approximately .01 to .015 millivolts per cell being charged. Therefore a 16-cell pack drops between .1 and .2 volt; a 4-cell pack drops between .04 and .06 volt. This can be observed by plugging a voltmeter into the voltage jacks.

After charging, the batteries were slightly warm to the touch (if they are not, you didn't succeed in getting a peak-charge). A test of battery capacity using a device that discharged at a known rate verified that both packs had been peaked successfully and were charged to capacity. Since then, I have used the charger at the flying field and on my workbench, and it has worked well.

The charger comes with Astro Flight Zero-Loss connectors attached. If you are charging a pack that uses a different type of connector and have not made an adapter to join the two, it's easy to pop the male connector leads out of the black connector casing (which slides back along the insulated portion of the lead wire). The Astro connector leads can then be easily alligator-clipped to leads that have been fitted to a connector that matches your battery connector.

The model 110XL is housed in a thick-walled gray plastic case and measures 6¾x5¼x3 inches. The circuit board and controls are mounted on an aluminum faceplate that is bolted down to the case with Allen-head screws. Two fuses—a 7A and a 20A—

(Continued on page 116)

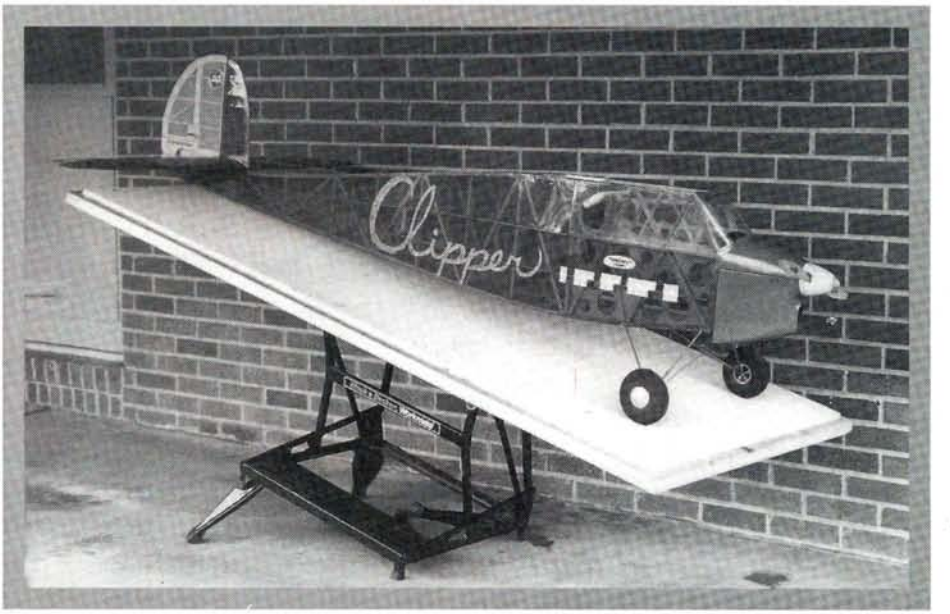
SPECIFICATIONS

Name: Model 110XL
Type: Ni-Cd fast-charger with peak detection
Input voltage range: 12 to 16 volts
Output: 0 to 5 amps
List price: $139.95 (discounted to as low as $110)

HOW TO

Lon's Building Mate

by LON TURNER



Tilted lengthwise, yet still very stable.

The hideaway workbench

WHEN I'M involved in a project, I can't seem to clean up as I go, so the closer I get to the finished airplane, the "cruddier" the shop gets! I made a rule that I would clean up the shop before beginning any new project. I manage to obey that rule most of the time.

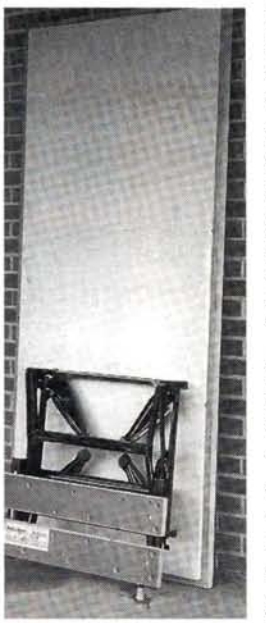
Once in a while, though, I get the "hots" to build something special. When this sort of urge hits me, it's usually "full-speed ahead." This time, it was John Pond's 10-foot Comet Clipper. Cleaning the shop looked like a three-day job. I figured I could have the plane framed up in not much more time than that.

It was clearly time to create the perfect portable building board!

My Building-Mate table uses the incredibly versatile Black & Decker Work-Mate as its base. Even if you never build my table, you owe it to yourself to own one of these gadgets.

The Black & Decker Work-Mate is a collapsible work table with dual height. Its top is composed of two wooden halves that open and close like a vise, using two screw assemblies. To make any sort of specialized tabletop, you need only attach a piece of 2x2-inch lumber (actually, 1¾ x 1¾ inches) to the underside for the jaws to grip.

Top: Building-Mate at full height and level. Below: level, but lowered by folding all legs. Note relation to chair back.



"Up against the wall!" Very little storage space required.

Requirements for the new building table were that it be:

- Absolutely flat and straight.;
- Long and wide enough to accommodate any project I might decide to build;
- Lightweight and portable;
- Covered with a material that grips pins securely.

Hollow luaun interior doors make great building boards. The materials and methods of construction used make them flat, true and lightweight. Damaged doors are available at almost any builders'-supply store. Be sure to sight along all edges for warps or breaks caused by improper storage and handling. I found a beauty with a fist-sized hole in one

side. It cost me $10. A piece of finished 2x2 cost less than $2. (Again, make sure it's straight.)

I have always covered my building surfaces with a 4x8-foot sheet of fibrous material used as sheathing and insulation on homes, etc. Brands that come to mind are Cellotex and Homasote. I couldn't find any of this material this time. Builders have switched to foam, which works better for them, but not very well for us. It just won't hold the pins firmly when you try to bend a piece of firm ⅜-inch square stock along a plan.

Hollow door with clamping strip attached.

I did, however ferret out a pack of suspended-ceiling tiles (2 inches x 4 feet) with slightly damaged corners. I got four for 25 cents each. I glued and clamped the 2x2 lengthwise down the exact center of the damaged side of the door. When the 5-minute epoxy set up, I was able to clamp the tabletop into the Work-Mate for the first time, making it a breeze to finish the work surface.

Tilted...note legs of Work-Mate.

The ceiling tiles work fine. A few butt joints won't hurt a thing if they're square and tight. The material tends to be a little crumbly, so I decided to move in 2 inches from all edges to forestall damage from handling. I spot-glued the finished side of the tiles (with all of the sound-trapping holes) down, leaving the firmer back side up. I used dots of soluble glue so that the material will be easy to replace down the road.

Less than 2 hours after I brought the stuff home, I started building the Clipper!

ON-THE-JOB ADAPTABILITY

I began with the W-M (Work-Mate) at full height while seated in a standard chair. It didn't take long to realize that it was a little too high. "No problem," says I—just fold the legs of the W-M under, which will lower the top about 8 inches.

It was at this point that I received an incredible surprise!

I had raised the near edge of the assembled table, and used my foot to fold up the two legs on my side. I let that side down, and was about to walk around to the other side to do the same. I suddenly realized that the tabletop was now kneeling toward me at a nearly perfect height and angled like a drafting table.

It felt every bit as solid as before, and since both sets of legs have rubber feet, there was no sliding around. What a delightful surprise!

I soon had enough pieces pinned to the table to prevent stuff from sliding or rolling off. (Like round X-Acto knives—yikes!) Temporary fences can be pinned or clamped to the surface if you have this problem.

When I started to have to reach too far, it was simple to raise my side, pull the legs down with my foot, move to the other side and tilt the table to that side. This table will also tilt lengthwise!

That airplane framed up more quickly and comfortably than any other I've done.

If there's a fault in this setup, it is the amount of overhang on each side of the W-M when using a full-length door for the top. This never presented a problem. The W-M is so solid that I had completely forgotten my concern by the time the plane was finished. I got careless once during radio installation and rested my considerable weight on one end. It tilted, but gently, without spilling anything.

For you guys who are forced to build in the bedroom, then make it all disappear before bedtime, this rig will change your life. And if you need to build a workshop, the Work-Mate will help you with that, too.

Now I gotta go clean up mine. (Ugh!) ■

GOLDEN AGE OF R/C

HAL DeBOLT

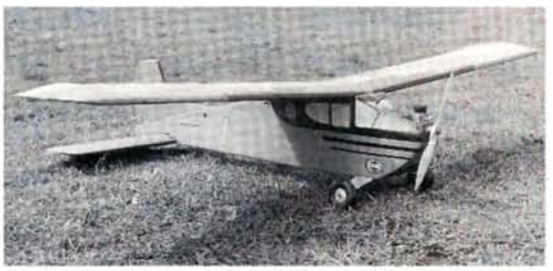
MORE FOR YOUR MONEY THAN EVER BEFORE!?

Scale is great today? How about this '50s Nats winner by Bill Dean of NYC? (Bill was active in publishing.)

HAVE YOU ever compared the price of today's R/C equipment with prices of the early equipment? In the '50s, the average weekly wage was $50; today, it would take $5 or more to buy what $1 would buy way back then. We can now buy a 4-channel control system for approximately $150; that's comparable to $30 or less in the '50s! But what did we pay *then* for a single-channel reed system?—$500 or more! That would be like paying $2,500 today! The advent of pulse systems and subsequent mass production eventually led to better deals for us, so it isn't hard to see why "pulse" was so popular.

POPULARITY OF PULSE

A while back, I discussed "pulse" systems, and John Pizzicara of Grand Junction, CO, sent along some interesting information. He's a flight instructor, but as a schoolboy, he experimented with pulse systems.



The original LW Senior was orange with black trim and silver windows. Note the black lightning design on the wing leading edge.

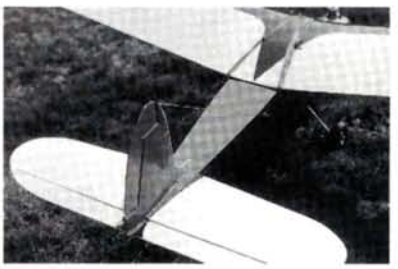
John provides an excellent description of early pulse systems. He also made a particularly interesting comment about the term "channel." Today "4-channel" means four separate controls; reed systems require two channels for a single control. Pulse systems for competition were generally classified as "single-channel," yet they could operate as many as three controls! Confusing?

John clearly describes a pulse system:

Just as with an escapement system, the R/F carrier was modulated with an audio tone. This tone was turned on and off by the transmitter. The receiver passed this action on to a relay, which had both a positive and a negative contact. The motorized actuator was fed both potentials by the relay, and the rotation would reverse with each polarity change. If the "on" and "off" pulses were equal in length, the actuator motor really didn't move, but stayed in "neutral." When the pulse was on for longer than it was off, the relay passed on more of one polarity than of the other. The result was that instead of the actuator moving equally far in both directions, it moved farther in the longer polarity direction. Thus, the control surface was deflected farther in that direction. A control always moved in two directions (in a "wagging" fashion), but it would move farther in the commanded direction. It should be noted that if the transmitter pulser had an infinite action, the control surface could be moved minutely—voilà, proportional control as well!

John explains that when the idea had been perfected, a second control was easily added. The transmitter pulser was modified so that it could increase and decrease the number of pulses transmitted per second and vary the on-to-off time. A discriminator was added to the receiver; it recognized rate changes and fed this information to a second actuator—two controls with "one channel." A third control was often added, too.

The original LW Cruiser was orange with black trim, a red lightning bolt and silver windows.



Torsion rods connected the pulse actuators and the control surfaces. At the surfaces, "yokes" transformed the rotating action into a linear surface movement.

An escapement associated only with the "carrier signal" could change the engine's speed. A momentary transmitter switch shut the carrier off and allowed the escapement to cycle in the same way as regular escapement-style control systems. Of course, as with most things, all this didn't come overnight. There had to be constant tinkering with relays and actuators.

BUILDING YOUR OWN WAY BACK WHEN

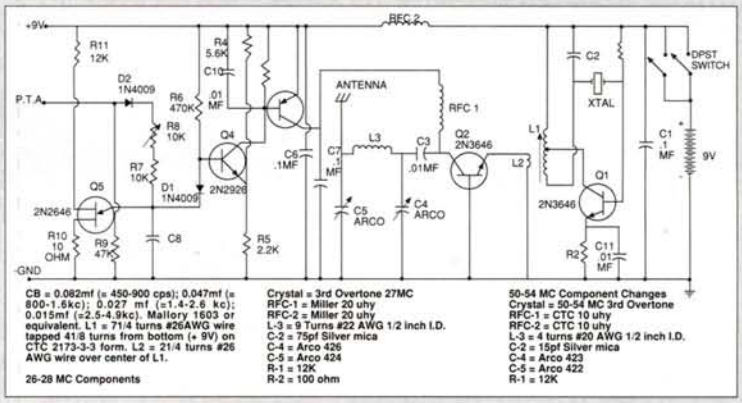
Way back in the "golden age," many of us enjoyed assembling our own radio equipment and took as much pride in watching it *guide* a model as we did seeing our model fly. We *had* to build our own R/C equipment, and there was much experimentation; in fact, many of those experimenters paved the way to what we now have.

Model Airplane News today contains the finest coverage of our sport. It has changed a lot over the years, but some things are the same. For example, the early issues always had a "new product" section; this was popular because R/C was being quickly commercialized, and the new items shown were of great interest. We needed so much!

There would always be a feature article on someone's latest fabulous R/C model—complete with details of its design and construction. New ways of doing things were found every day!

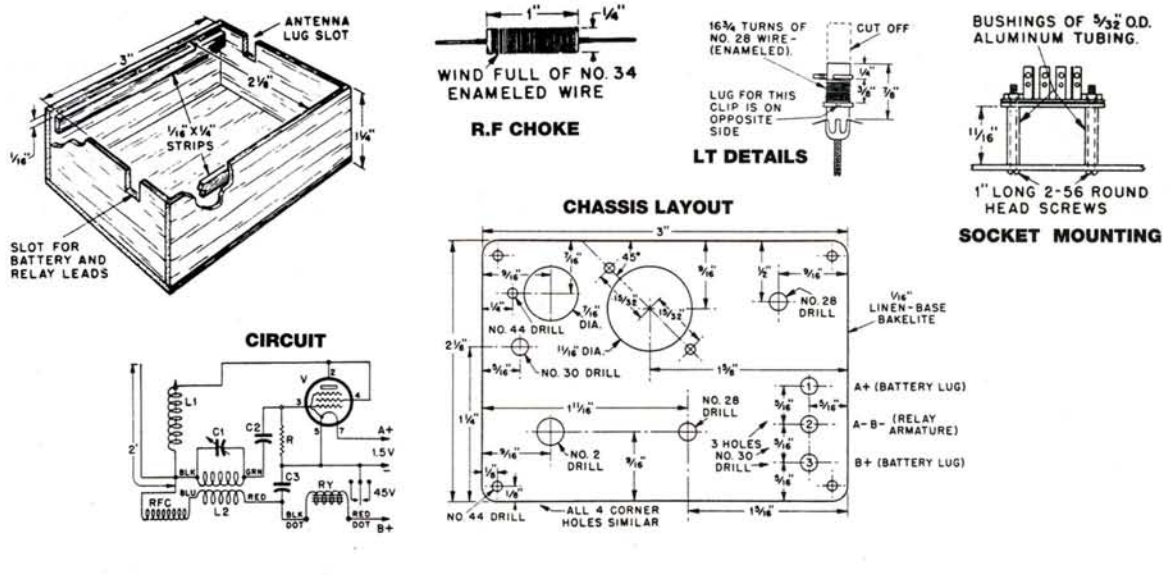
Most prominent would be a construction article on a new *electronic* item; the instructions included circuit diagrams, the design philosophy behind the innovation and a list of its components (with sources). The article would often give complete details on how to build an R/C system, and certain subjects took several issues to cover completely.

Ed Lorenz and Howard McEntee were leading advocates of the "build-your-own" approach. Ordinary modelers were helped to get into electronics, learning the differences between diodes, capacitors and resistors, etc. Working with electronics became very popular.

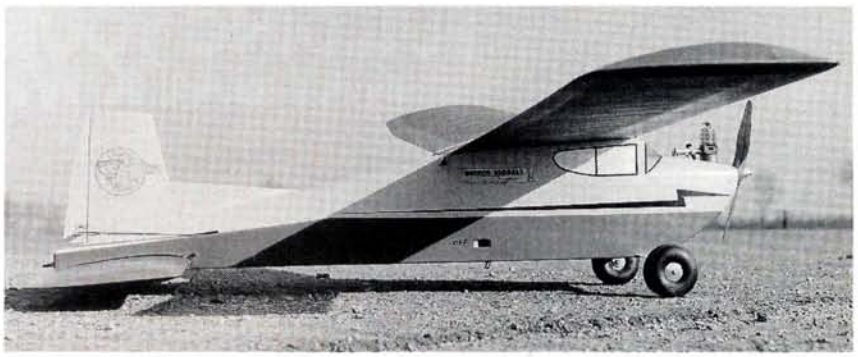


There were more ham radio enthusiasts, CB was new on the scene, and stereo/audio equipment was in its infancy. Our towns had electronic-parts-supply outlets where we bought all the strange bits and pieces we needed. Visiting them was as fascinating as a trip to a hobby shop! We also had our own mail-order sources such as Ace R/C and Lafayette in NYC.

Does any of this ring a bell with you? Do you recall the tinkering we did and the midnight oil we burned on some newfangled R/C thing?—and the joy (or frustration!) when the thing actually worked (or didn't!) in flight? It's understandable that John Pizzicara bemoans that this is missing from R/C today (see main article)—



Construction articles on electronics furnished all the necessary details. This one is for an improved receiver (note that it even includes details on a wooden box). Schematics were like road maps with strange names. Junctions indicated mileage (voltage) to be expected from point to point.



The original LW Trainer. The wing, stabilizer and lower fuselage were red; the rest was cream with a black "lightning bolt."

PULSE WASN'T PERFECT!

The initial drawback with pulse was the constant control "wagging," which John says was greatly alleviated as more ingenious systems were introduced. Why did pulse systems drop by the wayside? Would you believe they never *really* did? Our modern systems are developments of the original principle!

John says he enjoyed his early struggles with R/C systems, and he's actually sorry that we lost that along the way.

GONE, BUT NOT FORGOTTEN!

Marcial Davila of the Mexico City R/C Club reminds us about another great activity that's now missing from our lives. He searched for plans for the LW Custom bipe, and Tom Dixon of Marietta, GA, eventually helped him. Senior members of the Mexican Club are now getting into OT R/C, and the Custom will be Marcial's tribute to OT R/C.

In '61, the club held an invitational contest, and he remembers the expert American fliers who attended—including Jim Grier, Bob Dunham, John Brodbeck, Howard Bonner, Ray Downs, Ed Kazmirski and me. As you can imagine, Mexico's best were there, too, and it was a real "red-carpet" event! (I remember staying at Marcial's parents' wonderful mansion.)

And how did *this* "expert American" do? At the city's mile-high altitude, my engine wouldn't even start! I learned the hard way that higher compression is required at higher altitudes!

Anyhow, it's great to hear that this fine group is still active. It's sad that events such as the one in Mexico City, the Junior Birdman, Plymouth, Scripps Howard, NY Mirror, Philly Inquirer, etc., are long gone. They added so much to model aviation!

SWAP-SHOP SUCCESS

Duie Matenkosky (VR/CS member no. 5) of Murraysville, PA, checked in to say that, after years of looking in "swap shops," he at last has two very early operational R/C systems. One is a Citizen-Ship super-het single-channel with escapements, and the other is a Min-X pulse with a Rand LR-3 actuator. Both have been restored, and they'll be flown in the two LW Trainers he recently completed for the purpose. A Cub .09 and a Max .15 really put the icing on the cake of authenticity!

For utmost authenticity, Duie need to know the color scheme of the original LW Trainer, and I think others might be interested in this, too. So here, for the record, are the colors of the original Live Wires:

- **Finish**—all versions: Aero Gloss dope;
- **Trainer**—cream with black and red accent trims;
- **Senior**—orange with black trim;
- **Cruiser**—orange with black and red accent trim;
- **Champion**—cream with orange trim and black numbers.

Well, whether you mix and match or paint them purple, make sure of one thing: have fun! ■

ROTARY-WING ROUNDUP

NEW HELI PRODUCTS

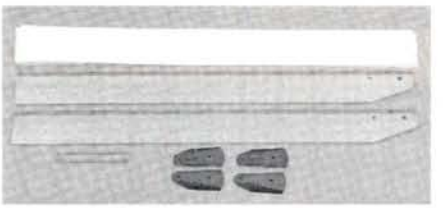
MINIATURE AIRCRAFT USA
XL-Pro Graphite X-Cell

The XL-Pro Graphite helicopter (held here by Tim Schoonard, the vice president of Miniature Aircraft USA)—is offered as both a multi-stage upgrade for X-Cell .60 mechanics and as a complete, fully loaded FAI helicopter kit. The conversion kit consists of the standard XL-Pro components necessary to convert an X-Cell .60 (standard or custom) to the XL-Pro configuration. They include: complete graphite frame set, all push/pull mechanisms, a fuel tank, a fiberglass canopy, a complete new collective arrangement and all the hardware necessary to make the complete conversion.

The complete XL-Pro kit consists of all upgrade and high-performance equipment currently used by top FAI pilots. The modular layout allows quick assembly and service without any alignment changes. Specifications: height—16.75 inches (425.45mm); overall length—54.50 inches (1384.30mm); rotor diameter—up to 61 inches (1549.40mm); tail-rotor diameter—11.25 inches (285.75mm); total weight—9.50 to 9.70 pounds (4.3 to 4.4 kg.).

Kit nos.—1006 (complete kit), 1006-1 (conversion kit); prices: $1,399.95, $429.95

Miniature Aircraft USA, 3743 Silver Star Rd., Orlando, FL 32808; (407) 292-4267; fax (407) 292-4296.



GREAT PLANES
Kyosho Concept 60 Expert Main Blades

Designed specifically for hot-dog-type aerobatics, these blades feature a plywood leading edge that's made of laminations of hardwood and resin. This gives a better chordwise CG for sure tracking and best response at the higher head speeds required for aerobatics. The blades also have a special thin adhesive covering for best performance.

Part no.—KYOE7505; price—$119.95

Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826; (217) 398-6300.

JR REMOTE CONTROL
160 Dual Sensitivity Micro Gyro

The JR NEJ-160 Dual Sensitivity Micro Gyro lets electric helicopter fliers reap the performance benefits of dual-gain settings. With a gyro that has dual-gain sensitivity adjustments for both hovering and forward flight, the user is able to tune a model more precisely for these two flying modes. The 160 gyro is the size of a typical, micro, electric heli gyro, yet it features dual sensitivity. Weighing only 1.4 ounces, the 160 doesn't add unnecessary weight that would inhibit model response, and, at a total volume of 1.7ci, the 160 will easily fit on any electric helicopter.

JR has increased the total range of gain adjustment by about 50 percent compared with the previous JR electric heli gyro (the NEJ-150). This gives the user more than enough gain authority for all types of setup.

Price—$149.95

Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

AEROBATICS MADE EASY

(Continued from page 12)

Another hint in setting up VTR: it seems to perform best with a knee setting that is high—say, around 80 to 100 percent of stick throw. Here is another case where some experimentation is needed to determine what is best for your particular aircraft and flying style.

EXPONENTIAL

The last, but not least, of the rate-changing functions is exponential (EXPO). This is easy to set up, and when it's right, it's very effective. It gives a gentle feel around neutral, plenty of throw at the extremes and a very smooth transition in between (see Figure 3). There are a couple of things to remember when you set up EXPO. First, start low and test-fly your airplane. By low, I mean start at around 25 to 30 percent exponential. Second, some radios permit you to set up EXPO in either direction. In other words, you can get the opposite effect—with more throw around neutral and less around full-stick deflection (possibly making the airplane difficult to control!). EXPO seems to work well on all controls, and some fliers use it on all control surfaces.

The only problem with EXPO is that it can be a little too soft around neutral. If you dial-out some EXPO to minimize the softness, the benefit of EXPO is diminished. If you can't find a comfortable compromise in EXPO, try VTR or good old-fashioned DR.

All R/C pilots have their particular preferences. I like the following combination: DR on rudder, VTR on ailerons and EXPO on elevator. This may change next week, but for now, it seems to work well! By the way, if your radio has this feature, I also recommend using some EXPO on throttle. About 20 to 25 percent seems to take out the bottom-end sensitivity.

I hope this gives you some food for thought. Some experimentation might help you extract a lot more performance out of your plane and fun out of flying it. Till next month! ■

TOUCAN

(Continued from page 33)

symmetrical airfoil, almost no reflex is needed. Excessive reflex will require too forward a CG and the model will be very draggy, have low lift capability, and porpoise. (Professor Phugoid can tell you the theory, if you want to look it up.)

Use any of a variety of finishes on the Toucan. The model could be painted, since it is a solid wood covered structure. If you are trying for an especially light version, a couple of coats of Pactra's* Formula-U Urethane is all the finish required. Since I fly in places with killer lift and lumpy landing sites, I wasn't terribly concerned with weight and covered the entire model with Goldberg's Neon Green Ultrakote. I find it

(Continued on page 104)

Secrets for better lateral control

Roll Control Design

by ANDY LENNON

DESIRABLE ROLL OR lateral control characteristics are important for good and easy maneuverability.

There are several types of roll control in use on today's model aircraft:

- none or minimal (via roll coupling)—on rudder and elevator-only models
- conventional ailerons
- external airfoil ailerons
- flaperons
- spoilers and slot lip ailerons
- all-moving wings (pitcherons)
- all-moving horizontal tails (stabilators)

The following discusses the advantages and disadvantages of each type.

NONE (OR MINIMAL)

This form of rudder-only lateral control is popular for sailplanes and some powered sport models. Wings for this type need additional dihedral. For powered models this would be 5 degrees for high wings, 6 degrees for mid wings and 7 degrees for low wings.

Thermal gliders have polyhedral—typically 5 degrees from root to three fifths of the semi-span, with an increase of 3 degrees from the polyhedral joint to the wingtip. On this type, when rudder is applied, the model yaws. Air strikes the wing at a slight diagonal. For the wing on the outside of a turn, the wind that strikes the wing at any given point on the leading edge exits from the trailing edge at a point slightly closer to the fuselage. Because of the dihedral, there is an effective increase in angle of attack. This situation is reversed on the opposite wing. Both cause the model to roll. It is important that such models have good spiral stability.

CONVENTIONAL AILERONS

In general, this type falls into two categories: outboard, or "barn door," and strip ailerons. Outboard ailerons (see Figures 1A, 1B and 1C), usually are 25 percent of the wing chord in width and 35 percent to 40 percent of the semi-span in length. Being farther from the model's CG, they have more leverage. One serious disadvantage is that, with equal up and down movement, they produce greater adverse yaw than do strip ailerons. The downgoing aileron has more drag than the upgoing, and this unequal drag tends to yaw the model in a direction opposite to the turn commanded.

A remedy for this condition is aileron differential, where the upgoing aileron's angular travel is 2 to 3 times that of the downgoing. This author uses a modified frise, top-hinged aileron with a differential of 2.5:1. The extended lower, forward lip projects into the air stream below the wing when the aileron is raised, producing drag that favors the turn (see Figure 1A). Turns are made without use of rudder. Figures 1B and 1C show two other forms of barn-door ailerons.

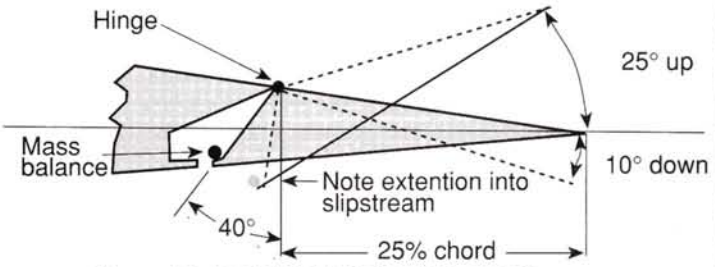


Figure 1A. MODIFIED FRISE AILERON

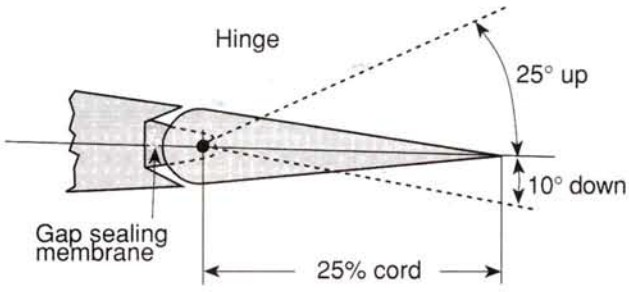


Figure 1B. PLAIN AILERON

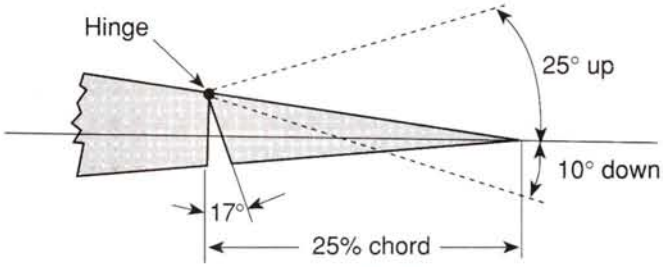


Figure 1C. TOP HINGED AILERON

The outboard location permits the use of flaps spanning 60 to 65 percent of the wing's semi-span. This wide, short type of aileron should be mass balanced for flutter elimination (see "Flutter, Causes and Cures," by Carl Risteen, in the March and April '93 issues of *Model Airplane News*).

Two other forms of aileron developed to overcome adverse yaw are slotted and frise ailerons. Use of differential aileron is more effective in producing desirable yaw moments than is the use of either of these two aileron types. Both slotted and frise ailerons require more deflection than plain ailerons for the same roll rate.

Strip ailerons (see Figure 2) are long, narrow and almost full span. They simplify wing construction, and they produce less adverse yaw than outboard ailerons, since their center of area is closer to the CG.

Most are actuated by servos

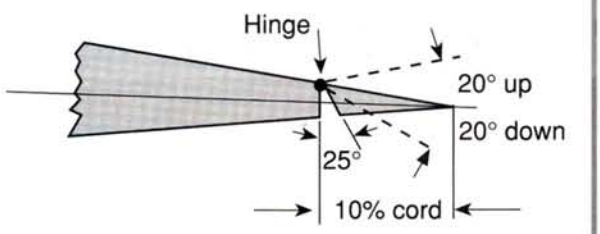


Figure 2. STRIP AILERON

moving horns on their inboard ends so that differential is easily introduced. Made of solid balsa trailing-edge stock, they are prone to flutter (three flutter incidents at this author's club field in 1991) and should be mass balanced at the outboard end to avoid this problem.

EXTERNAL AIRFOIL AILERONS

External ailerons were a Junker's development, and may be seen on some full-scale ultralight aircraft flying today. As Figure 3 shows, these consist of small separate wings tucked under the main wing's trailing edge, which provides a slot effect over the small wing. These are full span; the outboard portions form ailerons, and the inboard form a type of slotted flap. Hinged externally, they should be mass balanced for flutter elimination.

FLAPERONS

Flaperons are a form of plain aileron that can be operated as ailerons and drooped simultaneously as flaps. They extend for most of the wing's semi-span, like strip ailerons.

When in the fully lowered position as flaps, and then used as ailerons, there is a high degree of adverse yaw that cannot be overcome by aileron differential action.

Rudder control, either manual or electronic, must be introduced to counter the adverse yaw of this type of roll control. Mass balancing is recommended.

SPOILERS AND SLOT LIP AILERONS

Figure 4 shows a typical spoiler. Provided its leading edge is beyond 70 percent of the wing chord, there is no lag in the control's aerodynamic action. Only one spoiler operates at one time—the one on the inside of the turn. The opposite spoiler stays retracted. They provide positive into-the-turn yaw, work inverted, and require no mass balancing. A version of the spoiler, sometimes called "slot-lip aileron" (shown in Figure 5) was used on the wings of the Crane I in Figure 6. Full-span slotted flaps are fully extended and the right-hand spoiler is raised. Leading-edge slats and their slots show clearly. In Figure 7, Crane II (black wingtips) is shown climbing steeply after a very short takeoff run, flaps half extended. The right-hand spoiler is just being raised to initiate a right-hand climbing turn.

This form of roll control proved very effective on both Crane I and II. The roll rate was fast and worked inverted. With flaps lowered, roll control was very crisp at low speeds, since raising the spoiler destroyed the slot effect over the flap, reducing its additional lift. Yaw was favorable. This model's performance, at low speeds particularly, was spectacular.

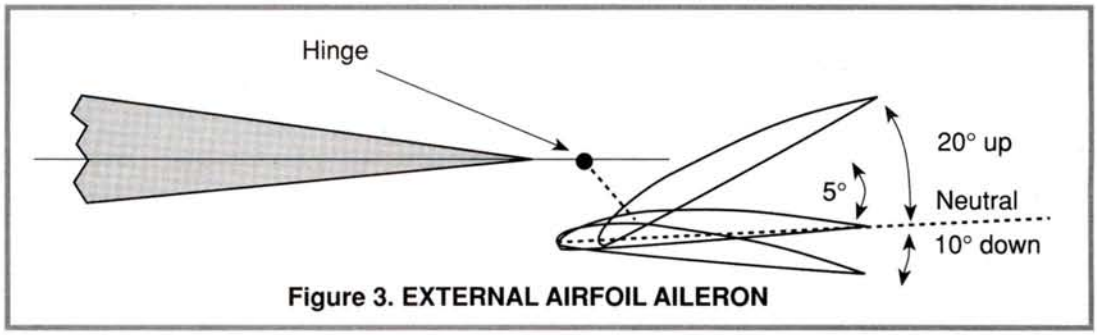


Figure 3. EXTERNAL AIRFOIL AILERON

ALL MOVING WINGS (PITCHERONS)

These are a recent development for R/C sailplanes (e.g., the Sig Samurai slope glider). Each wing panel rotates around spanwise pivots located at the wings 1/4 M.A.C. Both are controlled by one servo, but considerable differential is needed to offset adverse yaw.

Very few degrees of rotation are needed since each wing panel rotates in its entirety. The wing-fuselage joint would need special attention to avoid local separation and increased drag.

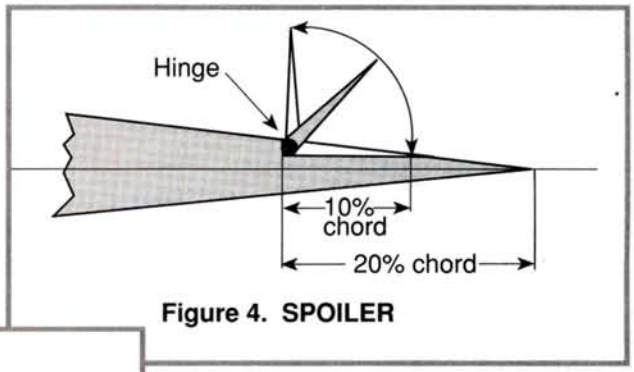


Figure 4. SPOILER

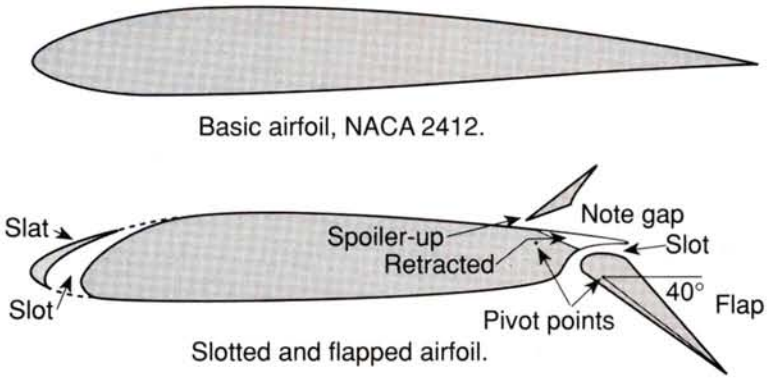
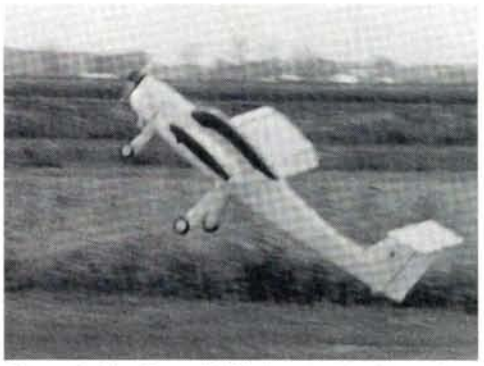


Figure 5. CRANE WING SECTIONS

ALL MOVING HORIZONTAL TAILS (STABILATORS)

Some recent jet fighters use such tails. They move in opposite directions for roll control,

Figure 6. The author's Crane I. Note the fully extended flaps; the right-hand spoiler is raised and the leading-edge slats and slots show clearly.



PHOTOS BY ANDY LENNON

Figure 7. The Crane II climbs steeply after a short takeoff. The right-hand spoiler has just started to rise for a right-hand, climbing turn.

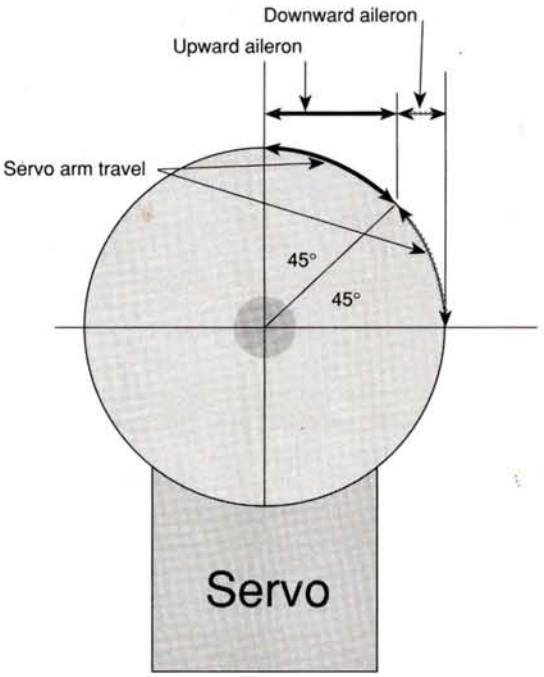


Figure 8. AILERON DIFFERENTIAL
(SCHEMATIC FOR ONE AILERON LINKAGE)

and up or down for elevator action—or any combination of the two. They seem very effective and, for a model, higher A.R.'s would provide longer moment arms. Adverse yaw would be small.

Pivoting on the spanwise pivots at 1/4 M.A.C. would result in low operating loads, as for all moving wings. This form of roll control might have application on pattern ships, leaving the wing free for full span flaps.

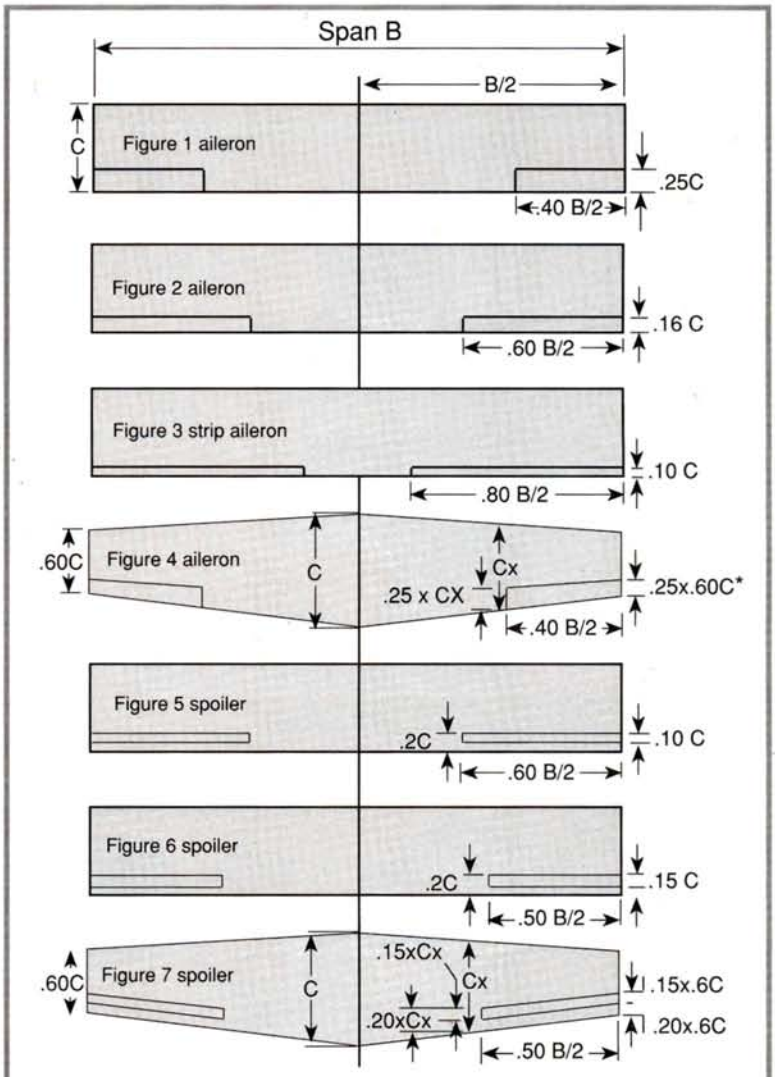
AILERON DIFFERENTIAL

Figure 8 shows how to use a servo's rotation to produce aileron differential.

GAP SEALING

Wind-tunnel tests have proven that a 1/32-inch gap on a 10-inch-chord wing will cause a loss of rolling moment of approximately 30 percent. A gap seal for all control surfaces is suggested. Figure 9 on page 45 of the November '91 *Model Airplane News* provides a hinging method that has proven durable and inherently gap sealing. For other types of hinging, some form of gap seal is advised.

Figure 9 provides suggested proportions for ailerons, strip ailerons and spoilers that were developed by NACA. They are good starting points when you are creating your own designs. Hopefully, this outline of roll-control design has proven enlightening and useful. Happy flying! ■



Suggested aileron and spoiler geometries for model aircraft, from NACA Rpt. No. 605, Resume and Analysis of NACA Lateral Control Research, Weick & Jones, 1937.

*** 25% of 60% of the full chord.**

Figure 9. TYPICAL CONTROL SURFACE GEOMETRIES

TOUCAN

(Continued from page 98)

easier to cover the fiberglassed areas if I precoat them with Coverite's* Balsarite adhesive. Decorative blazes were Neon Yellow on top and black on the bottom. The lettering was Neon Orange with black outline. I like to keep my models conservative.

A version built by Bill Del Hagen has a black fuselage, neon light green wings and tail, but features a Toucan's white head with eyes and bright orange beak on the nose; it's really cute, and visible in flight.

FLYING

OK! Your model is built, the controls are installed, you balanced it as the plans say, and now what? Well, I'm pretty chicken myself, and hate to climb down cliffs to pick up wreckage. There is an easy way to do a bit of testing safely before committing to that fateful first toss. Stealing a trick from model rocketeers, I do a "swing test." Take some strong string, tie a loop around the fuselage just ahead of the wing, tape the string to the middle of one wingtip and extend it about six feet farther. Swing the model around like a rock on a string. If it wobbles up and down, it is balanced too far back. It should track smooth and true. Try it upside-down also; it should fly slightly lower than right side up due to the reflex trim setting. Experiment with the CG location and reflex position of the elevons to get a feel for what is right and what isn't.

Well, I guess it is time to throw your Toucan off a cliff. Note that the Toucan is not a floater—either have a very light (16 ounces) model or lift capable of flying a typical power slope scale model. When flying Toucan, keep the speed up. It won't stall or snap-roll, but you sure can mush your way down the cliff if you keep hauling back on the stick to try for more lift. Have courage, get the speed up and you will be rewarded with a decent L/D.

After getting the initial trim settings to where you can fly the plane comfortably, work on adjusting the CG and control sensitivities to your taste. I like to push the CG to the rear, and reduce the reflex angle until the model will dive continuously with only the slightest tendency to pull out. This will make the elevator throw very sensitive, and you may have to make adjustments to your linkages or programming. When a model is trimmed this way, very little elevator is required to fly inverted, and very little energy is wasted in compensating for excess stability. In addition, the model becomes insensitive to gusts. As you achieve this trim setup, you will see a remarkable improvement in the speed and soaring abili-

(Continued on page 108)

TOUCAN

(Continued from page 104)

ty of the glider. Flying wing balance point is incredibly critical!

So there you have it: your very own forward-swept flying wing (in your dreams, anyway). Now all you have to do is quit reading and start building. Let me know how you make out with your Toucan.

**Here are the addresses of the companies mentioned in this article:*
Tekoa, *3219 Canyon Lake Dr., Hollywood, CA 90068.*
Aerospace Composites Products, *P.O. Box 16621, Irvine, CA 92714.*
Model Magic; *distributed by Carl Goldberg Models, 4734 West Chicago Ave., Chicago, IL 60651.*
UFO; *distributed by Satellite City, P.O. Box 836, Simi, CA 93062.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
Pactra Inc., *620 Buckbee St., Rockford, IL 61104.*
Coverite, *420 Babylon Rd., Horsham, PA 19044.*
Dumas/Eagle R/C Graphics; *Dumas Products, 909 East 17th St., Tucson, AZ 85719; (602) 623-3742.* ■

SAITO

(Continued from page 62)

category, the APC* 11x6, turned 12,400 for its 79mph speed—right at the peak corrected b.hp. Second-place finisher, Master Airscrew* 11x7.5, ran 80mph at only 11,150rpm—within 7 percent of peak corrected b.hp.

The real surprise was the APC 12x8, which placed first in speed at 81mph—turning only 9,200rpm! That's a full 25 percent below peak corrected b.hp of 12,500rpm !

Because of the outstanding speed of the APC 11x6 through loops (39mph) and its good straight speeds (79mph) I believe that it's the best overall prop tested with our setup. The APC 12x8, however, presents a very interesting case: if it can produce the high straightaway speed of 81mph while absorbing only .52 corrected b.hp—or only 75 percent of the potential power available from our Saito FA-50 test engine—what would it do if it were modified to take advantage of this horsepower? Frank and I feel that trimming the diameter somewhat to increase rpm might do the trick—better overall performance.

The purist might suggest that such trimming would disrupt the aerodynamic efficiency of the design. This is a valid point, so perhaps experimenting more thoroughly within the APC family would be more rewarding. The 12x7 or 11x7 might prove to be just what is needed.

Frank Vassallo has suggested that we concentrate on comparing a maximum of two manufacturers' lines of propellers for each engine analysis, to determine the best within each group. He thinks that this would be better than our "hit-and-miss" technique employed in earlier "RPM" columns. Zinger, for instance, might fare better if its *best* prop were determined by testing many sizes from its line, rather than a "random" sample. What do you think? The head-to-head competition would still be there, with different manufacturers highlighted in each engine review.

HITS

- The seemingly low noise generated by the low-frequency exhaust note.
- The smooth, steady operation and the handling characteristics of the FA-50 at the flying field.
- The good fuel-consumption values.
- The excellent instructions and support tools (wrenches; feeler gauge) supplied by Saito.
- The steady 2,500rpm idle achieved on the flight prop.

MISSES

- The rough rear crankshaft bearing found during post-flight disassembly!
- The poor appearance of the muffler, after the engine had been operated for only an hour.

CONCLUSIONS

The Saito FA-50 is a higher-revving 4-stroke than any of its predecessors. It prefers to run with generally light propeller loads. In this regard, it acts more like a 2-stroke engine. This, I think, is partially explained by the highly over-square proportions of the bore to the stroke. The greater b.hp exhibited by this design compared with its ancestors can be attributed to the increase in displacement and the trend toward higher rpm peaks.

In closing for this month: thanks to so many of you who have taken the time to write to me. In future, to help me respond to your comments and questions more promptly, please enclose a SASE with your letter.

**Here are the addresses of the companies mentioned in this article:*
Saito; *distributed by United Model Distributors, 301 Holbrook Dr., Wheeling, IL 60090.*
Zinger; *distributed by J&Z Products, 25029 S. Vermont Ave., Harbor City, CA 90710.*
Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*
Condor Hobbies, *1733-G Monrovia Ave., Costa Mesa, CA 92677.*
Airtrax; *distributed by L&R Aircraft Ltd., 13645 Fisher Road, Burton, OH 44021.*
APC Landing Products, *P.O. Box 938, Knights Landing, CA 95645.*
Master Airscrew; *distributed by Windsor Propeller Co., 3219 Monier Circle, Rancho Cordova, CA 95742.*
Rev-Up; *distributed by Progress Mfg. Co., P.O. Box 1306, Manhattan, KS 66502.*
Graupner; *distributed by Hobby Lobby Int'l., 5614 Franklin Pike Cir., Brentwood, TN 37027.* ■

SPACEWALKER

(Continued from page 72)

watch him go through a couple of flights. You'll come away impressed. There's nothing in the books that this airplane can't do. We looped through the sky in big, gentle motions when the mood struck us, and we coerced one airplane into tumbling end-over-end when it seemed to be the thing to

(Continued on page 115)

by JEF RASKIN

HANSEN SCALE AVIATION VIDEO, VOLUME 18

Subject: *1992 quarter-scale competition at Las Vegas and more*

Source: *Hansen Scale Aviation Videos, 10807 SE Stacy Ct., Portland, OR 97266*

Summary: *Home-video-style coverage of contests, museums and old aircraft rebuilders*

List price: *$19.95 (buy four of their tapes at this price, and get one free)*

Approximate length: *2 hours*

There is nothing pretentious about this tape; even the use of an electronic titler is eschewed as the cameraman hand-holds the camera at a printed page to start the video. We get to see plane after plane after gorgeous plane. There is no stinting on video tape here; my timing came out to 2 hours and 2 minutes—longer than any other tape I've reviewed.

The Quarter Scale Association of America's 1992 contest at Las Vegas is the main topic, and we are first shown the static display and then a sample of the flying activities—mostly in the form of take-offs and landings. Special attention was paid to WW I Albatroses. Scale enthusiasts will find much to look at here as we are shown many details that caught the cameraman's eye. No systematic treatment was attempted.

The QSAA show packs its tents (we see them pack), and there's the Seidel 990 9-cylinder radial engine running on a test stand. It runs well, after which we are suddenly at the Pearson Air Museum in Vancouver, WA. We then visit with old airplane restorer Jim Appleby, who sweeps the floor around the fuselage of a SPAD during much of the interview. This is followed by a tour of the wonderful San Diego airplane museum, concentrating on the older aircraft, especially WW I Albatroses.

Cutting to the 1992 Northwest Model Expo at Puyallup, WA, we spend a quarter hour looking at the scale models displayed here, paying special attention to WW I Albatroses. Then it's east to an airfield near Spokane, WA, to the house and hangars of Skeeter Carlson, who has a fantastic collection of early aircraft in various stages of repair and disrepair. We get to explore. Notable is the rare "Student Prince" biplane.

A few minutes are spent watching a float-equipped Taurus fly from a pond, after which the tape closes with some old 8mm film of early (reed era) R/C flying in Oakland CA.

If you like to look at old planes and models, consider this video as an informal record of a trip up and down and up and down the West Coast by a dedicated modeler who just didn't have time to do a proper edit—only an occasional voice-over of a word or sentence, e.g., "This is a quarter-scale Albatros D.VS," by way of correction or explanation shows that it is more than raw footage. And by selling the tape, I'll bet the whole trip becomes a tax-deductible business expense—a tactic we can all learn from. I note that a tripod and dolly would also have been tax-deductible.

Hansen Videos has an extensive list of events and museums that they have covered since 1987. Most are two hours; a few are even longer. I think that the model aviation community is fortunate to have these events memorialized.

JUDGING AND FLYING PRECISION RC AEROBATICS

Subject: *How to be a proficient judge and flier of precision aerobatics*

Source: *Academy of Model Aeronautics, 5151 East Memorial Dr., Muncie, IN 47302*

Summary: *Four-square and all there. Professional, informative, complete, interesting.*

List price: *$15.00 (plus $2.50 S&H)*

Approximate length: *48 minutes*

There are many fine points to flying precision aerobatics, and a great deal of satisfaction in doing it well. If you use competition mainly as a spur to prod you into flying better than you otherwise would, and as a gauge to find out if you

(Continued on page 123)

SPACEWALKER

(Continued from page 108)

do. High-speed loops were very steady with the wingtips staying flat throughout. Rolls, both gentle and snap, were picture-perfect, too. And the Spacewalker II looks good during these maneuvers. Its size and grace make flying fun.

We think that you should take advantage of the flight potential of the Spacewalker II by installing the larger recommended engine. For 2-strokes, that's a 120, and for 4-strokes, a 160. As we said, we used a Webra 120 2-stroke speed engine; it puts out enough power to fly a barn door, so the Spacewalker II is small potatoes for it.

ALWAYS PREFLIGHT!

We did, however, suffer a frustrating engine experience. On the first three or four outings, we couldn't get the engine to last more than a few minutes in the air. It ran well on the ground, but once the plane was in flight, it would quit as if it were hot. For a while, we thought that the break-in process was extra-long, but when it continued for nine or 10 times in a row and performance started to suffer, we knew that there was definitely a problem.

After much investigation, we realized that in our preflight inspections, we failed to notice that the carburetor had loosened during the first flight (we had checked it before assembly, and it was tight), and this was letting too much air into the mixture and leaning-out the engine to the point at which it became hot enough to seize. The piston expanded faster than the cylinder and, when the clearances became too tight, the engine stopped running. We disassembled the engine and found that the piston ring had collapsed owing to this unintended, repeated abuse. We bought a new ring (it took about two weeks for the special-order part to arrive), installed it and reassembled the engine. Since then, the Webra has performed flawlessly. It always starts up with just a flick or two, and it idles with excellent manners. Remember, *always* check your engine before each flight!

As we said earlier, the Webra possesses abundant torque, but an important characteristic is the off-idle acceleration. When you throw in a lot of throttle—say, as you accelerate from a standing start on the runway—the Webra doesn't even hint at hesitation. In the air, the 120 is a joy, too. It has an excellent powerband for a wide range of flying conditions.

The Webra is a good match for the Spacewalker II because both are versatile and rock-solid. All in all, the Spacewalker II is a big success for Sig. It's a very sporty and easy-to-transport 1/4-scale craft that's legal for IMAA and QSSA fly-ins. This airplane is a winner!

**Here are the addresses of the companies mentioned in this article:*
***Sig Mfg. Co.,** 401 S. Front St., Montezuma, IA 50171.*
***Webra;** distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*
***Rev-Up;** distributed by Progress Mfg. Co., P.O. Box 1306, Manhattan, KS 66502.*
***Carl Goldberg Models,** 4734 W. Chicago Ave., Chicago, IL 60651.*
***Satellite City,** P.O. Box 836, Simi, CA 93062.* ■

CENTER ON LIFT

(Continued from page 85)

(removal would save more weight), and I know the fuselage can be made at least ¼ ounce lighter. I'll save the discussion of the wing-attachment method and tail construction for another column.

CST WORKSHOP '92 VIDEO

Some of you are reluctant to modify your building techniques to use composites. You've been building balsa models for a long time, and all this fiberglass, Kevlar and vacuum bagging is foreign stuff. A 45-minute videotape from CST, filmed in one of their workshops, offers a good introduction to composites. Matt Gewain discusses the many available composite materials and the tools and techniques that are needed to work with them.

Matt's construction examples include uni-

(Continued on page 116)

CENTER ON LIFT

(Continued from page 115)

directional carbon fiber, hollow-core Rohacell, carbon-fiber/Rohacell spars, and wings bagged with painted Mylar and molded fuselage parts. These examples show the many possible uses for composites in a model. The sample parts they make show where to use the three most common fabrics—fiberglass, Kevlar and carbon fiber.

The video also does an excellent job of describing the materials used in vacuum bagging and the the vacuum bag itself. It shows how to use supplies properly, e.g., the breather mat and peel ply. Matt explains one technique for the preparation of the wing-core and the wing-skin materials. He does the lay-up of a wing panel and puts the wing into the vacuum bag.

If you're inexperienced and want to learn about composites and how to use them, this tape would be a good introduction.

In next month's column, I will look at the capabilities of the new JR X-388 radio. See you then.

**Here are the addresses of the companies mentioned in this article:*

CST (Composite Structures Technology), *P.O. Box 4615, Lancaster, CA 93539.*

Terry Luckenbach, *5460 Colony Dr., Bethlehem, PA 18017; (215) 262-5226.*

DesignCAD 3D; *published by American Small Business Computers Inc., 327 S. Mill St., Pryor, OK 74361; (918) 825-4844.*

FeatherCut; *distributed by Tekoa: The Center of Design, 3219 Canyon Lake Dr., Hollywood, CA 90068; (213) 469-5584.*

Lee Murray, *LJM Associates, 1300 N. Bay Ridge Rd., Appleton, WI 54915-2854; (414) 731-4848.*

UFO; *distributed by Satellite City, P.O. Box 836, Simi, CA 93062.*

Northeast Sailplane Products, *16 Kirby Ln., Williston, Vermont 05495; (802) 658-9482.*

Airtronics Inc., *11 Autry, Irvine, CA 92718.*

RCD, *10729 Wheatlands Ave., Ste. C, Santee, CA 92071.* ■

110XL DC

(Continued from page 86)

are in mounts on the faceplate.

An excellent set of instructions was included. A chart provides the approximate charge times for different cell capacities. Read the instructions thoroughly before attempting to use the unit. So far, I have used the charger on 4-, 6-, 10- and 16-cell packs with excellent results. I highly recommend the unit. It's a rugged piece of gear that takes the guesswork out of fast-charging Ni-Cds, and it won't cost you an arm and a leg.

**Here are the addresses of the companies mentioned in this article:*

Astro Flight Inc., *13311 Beach Ave., Marina Del Rey, CA 90292.*

Trinity Products Inc., *1901 E. Linden Ave. #8, Linden, NJ 07036.* ■

VIDEO VIEWS

(Continued from page 109)

have learned well, then this tape will show you *exactly* what you should strive for. Looking at your flying with a judge's perspective is invaluable. Certainly my flying improved after I began serving as an aerobatics judge. On the other hand, if you enjoy precision aerobatic competition as a blood sport or want to help out by judging, then this tape goes from useful to essential.

The video itself is absolutely professional, very well organized, and the shots of aerobatic planes performing with grace and precision are superb. Well-known flier Ron Chidgey was the technical advisor and his experience shows in the tape's flawless accuracy.

In precision aerobatics the rules for models and prototypes are very similar, and judges are given the same advice. First, there's your (as opposed to the plane's) attitude: you must weed out all bias, have confidence in your judgment, be independent of what others think or say, and adhere strictly to the rules. You must have sound knowledge of the downgrade system and a clear image of what a perfect maneuver should be. *Judging and Flying Precision RC Aerobatics* explains all this, and goes on to set out what you need to know about the "box" in which the planes fly, the principles of scoring, the importance of judging flight path rather than attitude, errors in wind correction, the 1-point-for-each-15°-off rule, and more.

How the basic maneuvers should be flown and the most common errors pilots make are demonstrated with nicely done animation. The basics for all aerobatics consists of lines, loops, rolls, stall turns, snap rolls, spins, and loop-roll combinations; the tape covers them all. The difficult task of correcting for perspective at the ends of the box is illustrated with unusual clarity.

The AMA has produced a solid, straightforward presentation meant to educate and inform. There is no humor that might grow stale with repeated viewings (and this tape was meant to be watched more than once). It would be hard to present this material better. *Judging and Flying Precision RC Aerobatics* is highly recommended. ■

AIRWAVES

(Continued from page 8)

"Thanks to the richer mixture and a much higher latent heat of evaporation (about 425 Btu/pound vs. 116 Btu for gasoline), methanol will absorb at least 8.6 times as much unwanted heat as gasoline. This property alone will provide one third to one half of the needed engine cooling, versus a few percent provided by gasoline (the reason many model engines overheat when converted to gasoline and spark ignition). I picked up several miles per hour on one fast RPV by reducing the drag-producing engine-cooling air flow after converting to methanol. Cylinder fins can also be machined down for a reduction in weight and frontal area.

"Methanol has a much greater tolerance for fuel/air mixture inaccuracy. Gasoline requires much more accurate carburetion. Many conventional model engine carbs fall short when converted to gasoline.

"Virtually any engine designed for operation on gasoline can be converted to methanol for more power, cooler and cleaner running, and better acceleration and idle. The compression ratio can also be raised a couple of numbers or so for another 10 percent power boost, thanks to methanol's high octane rating of about 100 (lean) to about 120 (rich). Methanol may require a little more spark advance than gasoline for best results and a hotter spark plug to resist oil fouling. Before adding nitromethane, try a little more spark advance. Methanol's high latent heat also considerably cools the incoming fuel/air charge, increasing its density and allowing the engine to burn more fuel and produce more power.

"I never use nitro in large RPV engines, as I have found that I can get just about as much power boost at far lower cost and much less engine stress by optimizing the compression ratio and spark advance. (Nitro provides additional oxygen but lowers octane number, and that tends to cause damaging detonation.)

"The high latent evaporation heat of methanol makes it evaporate slowly, and it liberates heat slowly when spilled, so it's less of a fire hazard. Since a horrendous accident at the 1964 Indianapolis 500, gasoline has been outlawed and replaced by methanol. Burn injuries at the Indy 500 have been rare since.

"I would use gasoline only where long

(Continued on page 126)

HOBBY SHOP DIRECTORY

Retailers: Make your business grow with new traffic! Now you can advertise your hobby shop in the ***Model Airplane News*** **Hobby Shop Directory**. The listing will be published monthly and will be listed according to city and state. You have 3 to 4 lines, approximately 20 words, in which to deliver your sales message, plus space for your store's name, address and telephone number.

HOBBY SHOP DIRECTORY SPACE RATE

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420 W. S.R. 434 **(407) 327-6353**
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JINX MODEL SUPPLIES
721 Rockwell Ave. **(419) 422-5589**
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We specialize in R/C jets, both electric and gas planes. Dealer for Violet, Byron and Yellow Aircraft. Mail orders welcome.

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118-2838 E. Hastings St.
Tel: (604) 255-2838 **Fax: (604) 255-7088**
[4/94]

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1387 N. Military Trail **(407) 688-0669**
[5/94]

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(between 6th & 7th Ave.) **(212) 675-8922**
[6/94]

Send sales message and payment to
Model Airplane News,
Hobby Shop Directory,
251 Danbury Rd., Wilton, CT 06897.
For more information, call toll-free
(800) 243-6685 and ask for Arlene Melko.

PRODUCT NEWS

DOUBLE M ELECTRONICS
AD Cycler/Charger

Double M Electronics introduces the AD Series of cycler/chargers. The AD Series includes basic 2-channel models and models with multiple V/mAh selections per channel that offer greater flexibility. These models can cycle or charge separately, test battery loads and trickle-charge automatically. The units charge at an overnight rate (C/10) or at a quick rate (C/5), and they discharge at C/2.5. Trickle-charge is C/35. Operation is fully automatic, and each unit comes with an AC adapter and can also be powered with a 12V battery.

Part nos.—AD-2A (shown), AD-2B; **prices**—$89.95, $119.95.

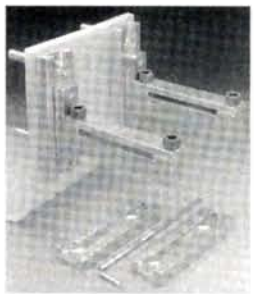
Double M Electronics, P.O. Box 159, Glenn Dale, MD 20769-0159; (301) 805-9361.

BOB VIOLETT MODELS
Maverick

The Maverick is an excellent first jet, and you can also use it to polish your flight techniques. The kit features a gel-coated epoxy-glass fuselage, hatches and ducts with Kevlar reinforcement; pre-sheeted flying surfaces; molded carbon-fiber parts for plug-in wings; retract mounting and servo mounting; all control hardware; and optional split flaps. Specifications: length—67 inches; wingspan—60 inches; wing area—700 square inches; weight—12 to 13 pounds; power—Viojett/BVM .81 or BVM .91.

Price—$595 (plus $20 S&H)

Bob Violett Models Inc., 170 State Rd. 419, Winter Springs, FL 32708; (407) 327-6333; fax (407) 327-5020.



KEY HOBBY ENTERPRISES
Kwik Mount System

With this mount, you can slide your engine on or off your plane in 30 seconds, or mount it on another plane. There's no tapping or drilling, and thrust adjustments are a snap. It comes with a lifetime warranty and free parts replacement if it breaks as a result of a severe crash. All parts and hardware are included for one mount that will fit two planes. The mount also comes with a locking key and fits 40 to 90 sizes.

Price—$19.95 (plus $2.50 S&H)

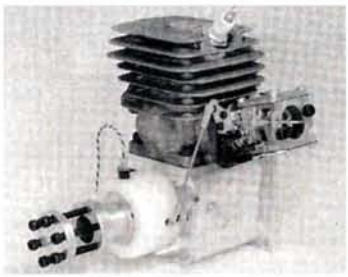
Key Hobby Enterprises, 8129 N. 35th Ave., #A2122, Phoenix, AZ 85051; (800) 882-0012.

DAVIS MODEL PRODUCTS/DAVIS DIESEL
Soundmaster

This is the Soundmaster large-engine, "Pitts-style," in-cowl muffler. The large SMQMOKI muffler fits engines such as the Webra 1.2, the Irvine 1.2, the Moki 1.5/1.8 and the O.S. BGX-1. The Soundmaster is constructed of lightweight steel, and it has built-in pressure taps. The compact in-cowl design quiets the engine without any power loss.

Price—$49.95

Davis Model Products/Davis Diesel, Box 141, Milford, CT 06460; (203) 877-1670.



WALKER MACHINE
Gas Engines

Walker Machine is pleased to announce that their WM Sachs gasoline engines are again available, e.g., the 2.6, the 3.2, the 4.2 and the 5.8. Assembled with original Sachs-Dolmar parts (crankshafts, connecting rods, pistons, cylinders and rod bearings), each features a C&H Electronics ignition, a Walbro carburetor and an NKG spark plug with a Bosch plug cover. The crankcase is CNC milled of 6061 T6 bar-stock aluminum. Each engine is test-run and comes with a one-year warranty on parts and labor.

Walker Machine, Rte. 3, Box 242A, Milton-Freewater, OR 97862; (503)938-6743.

MODEL ELECTRONICS CORP.
Super Box

Model Electronics Corp. has taken the most popular features of the available gearboxes and incorporated them into the Super Box—a gear-reduction propeller drive that is CNC milled of aluminum for durability. It has 12 gear ratios that range from 2.42:1 to 6.0:1 and an extra-long shaft that can be easily cut to fit each model. It comes with a propeller adapter, mounting screws, brass pinion gears and two ball bearings.

Price—$42.50

Model Electronics Corp., 6500 6th Ave. NW, Seattle, WA 98117; (206) 782-7458.

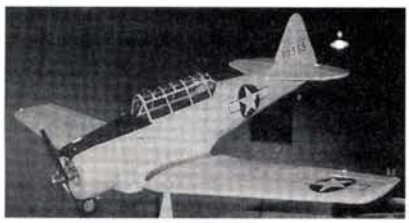
PRODUCT NEWS

DICKYBIRD MODELS
Warbirds

Dickybird Models' two, electric mini warbirds—the P-51D Mustang (shown) and the ME-109Messerschmitt—have vacuum-formed plastic body pods, prefabricated balsa sheet wings and prefabricated lite-ply and balsa fuses. Each model requires a 2- or 3-channel radio. Specifications: span—39 inches; length—27 inches; wing area—210 square inches; weight—19 ounces.

Kit nos.—DB-116 (P-51D Mustang), DB-117 (ME-109 Messerschmitt); **prices**—$19.99 (each kit; plus $4 S&H).

Dickybird Models, P.O. Box 1249, Westminster, CA 92684-1249; (714) 775-4153.



MIDWEST PRODUCTS
AT-6

With a wingspan of 81 inches, this large-scale airplane is legal for IMAA events. The kit includes Micro-Cut Quality® woods, precision die-cut parts and full-size plans. In collaboration with Midwest Products, Robart Mfg. will make a special retract gear for this kit. Specifications: wingspan—81 inches; wing area—980 square inches; flying weight—11 to 13 pounds; 2-stroke engine—.90 to 1.08; 4-stroke engine—1.20 to 1.50; radio—4-channel (5-channel for retracts).

Kit no.—177

Midwest Products Co. Inc., 400 S. Indiana St., P.O. Box 564, Hobart, IN 46342; (219) 942-1134.

U.S. AIRCORE
Ground Power Unit (GPU)

USAC's new GPU can be assembled in 30 minutes, and you can customize it to fit your flight-line needs. The GPU is made of super-tough, space-age, fuel-proof copolymer AirCore®. It comes in AirCore Blue with white trim, it doesn't require any gluing, sanding, or painting. It's big enough to carry a gallon of fuel plus a fuel pump, glow plugs, tools, a heavy-duty 12V battery, props, a starter and everything else you need at the flight line—yet it weighs only 28 ounces.

Part no.—USA 3020; **price**—$29.95.

U.S. AirCore Inc., 4576 Claire Chennault, Hangar #7, Dallas, TX 75248; (214) 250-1914.

AEROLOFT DESIGNS
Ramtec

Ramtec—the fan unit that's manufactured in Australia—is now available through its U.S. distributor, Aeroloft Designs. With a diameter of 135mm (5¼ inches), the Ramtec is designed for the most popular ducted-fan engines, including the O.S. 77, O.S. 91, K&B 82, KBV 82, Picco 80 and Rossi ducted-fan engines.

Price—$135 ($5 S&H)

Aeroloft Designs, 2940 W. Gregg Dr., Chandler, AZ 85224; (602) 838-0447.

ASTROFLIGHT
112PK Super Charger

The new 112PK Super Charger is a peak-detecting DC charger that can handle from 4 to 36 cells (250 to 4000mAh). It features a DC ammeter, a current-adjust control for varying the charge rate from 1 to 5 amps, voltmeter jacks on the front panel to monitor your batteries' voltage and an auxiliary 100mA trickle-charger to charge your receiver pack. It also has a built-in cooling fan and is input- and output-protected against overload and polarity reversal.

Price—$189.50

AstroFlight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242.

PRECISION AERO
Dress-Up Kit

Precision Aero announces the release of a dress-up kit for its popular Wild Thing 40. This kit contains everything necessary to give the model a new personality: vacuum-formed wheel pants, a canopy, hardware, and materials and instructions to build a cowl for either a 2-stroke or a 4-stroke engine.

Price—$19.95 (plus $4.50 S&H)

Precision Aero, 1561 River Highlands Dr., Oconomowoc, WI 53066; (414) 567-5341.

Descriptions of products appearing in these pages were derived from press releases by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor guarantee product performance. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Model Airplane News**.

Manufacturers! To have your products featured here, address the press releases to **Model Airplane News,** attention: Julie Soriano.

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If so, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

CONGRATULATIONS to Richard J. Dwyer of San Jose, CA, for correctly identifying the May issue's mystery plane as an EDO XOSE-1. Established in 1926, EDO Aircraft Co. was named after its founder Earle D. Osborne's initials instead of his name and, today, many refer to his famous floats simply as "edo's." By the end of WW II, aircraft like the Douglas DC-3 and the Curtiss SC-1 Seahawk were outfitted with EDO floats; in fact, 95 percent of all the floats used by the U.S. Army and Navy came from Osborne's facility. In 1944, EDO decided to produce what it predicted would be the best floatplane ever designed, and this craft became known as the EDO XOSE-1. Powered by a 550hp, 12-cylinder, inverted, air-cooled Ranger engine, the experimental observation scout had a range of 1,000 miles, a flight duration of six hours, a top speed of about 200mph and a cruising speed of 130mph. Two .50-caliber machine guns were mounted in the wings (one on each side), and its slim fuselage was filled by its radio transmitting and receiving equipment. The aircraft weighed 5,200 pounds and had folding wings to suit the Navy's storage requirements. Two prototypes were built, and only a few saw service in the Navy.

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News.** If already a subscriber, the winner will receive a free one-year extension of his subscription.

AIRWAVES

(Continued from page 123)

duration or range is needed in an RPV, i.e., where the much larger fuel weight and volume of methanol may be a problem. Although harder to find today, leaded aviation gas is preferred to automobile gasoline because it burns cleaner and richer."

For racing engines, the advantages of methanol conversion would seem to outweigh the disadvantages but, as Rob notes, it still comes down to personal preference. Do you have comments on this subject you would like to share with our readers? Write and let us know. TA

SWEDISH T-WINGER

Thank you for your assistance in straightening out my subscription problem. I can tell you that my first contact with *Model Airplane News* was in 1954. I was just a boy at the time, and my friends and I flew U-control models. In 1969, we began flying R/C models from drawings in *Model Airplane News*. We built models like the New Orleanian, Cutlas and T-Winger (photo enclosed). All were excellent constructions, and we had a lot of fun with them. Without exaggeration, I can say that without your fine magazine, I wouldn't be the model flier I am today. Thank you.

OLOF ELLIOT
Lyckeby, Sweden

Olof, thanks for your words of praise. We are always pleased to hear from modelers from abroad—especially from long-time readers. The T-Winger biplane you included a picture of looks like a fine model. Many of us here in the office also grew up reading our fathers' copies of "Model Airplane News." After 39 years as a reader, I hope you still find our articles interesting and thought-provoking. Thank you for your loyalty. GY

LEARNING ALONE

I am an 11-year old boy who is interested in R/C flying. I live in an area which, to my knowledge, has no R/C flying field or instructors. I am currently building a Carl Goldberg Gentle Lady, and my dad and I don't intend to install a motor or a radio. (It's more for the building experience than for anything else.) Would you recommend one of the U.S. AirCore planes for a beginner who probably won't have a flight instructor?

ADAM YOUNGMAN
Baxter, Minnesota

Adam, U.S. AirCore models really do hold up under the rough conditions of the "sudden-landing-syndrome." Try the AirCore 40 Family Trainer or the Knighthawk. Of course, if you can find fellow fliers, it will really help you to succeed. Contact hobby shops in nearby towns and find out who's flying in your area. CC

WANTS MORE ON MADERA

The story on the Madera Unlimited Air Races in the February issue was, to say the least, very exciting. I'd like to learn more about the planes that race there. For starters, I'd like information about the engines—not just the technical end, but also where they are made and how much they cost. Even more informative would be a construction article on some of the planes—in particular the first-place Mustang (no. 00). Any such construction article could focus on the composite fuselage construction used in this Mustang. I look forward to reading more about the races. Keep up the good work.

SEAN MAHEDY
Hillsdale, Ontario, Canada

Sean, we agree that unlimited racing is one of the most exciting R/C events to come along

(Continued on page 130)

CLASSIFIEDS

RATES: non-commercial—25 cents per word. No charge for name and address (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.**

To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. **SEND AD AND PAYMENT TO: CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.**

R/C WORLD ORLANDO, FLORIDA CONDO RENTAL: 2 bedroom, furnished. Available weekly or monthly. Low rates. 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For information, please call or write: R/C World, 1302 Stearman Court, Orlando, FL 32825; (407) 380-6359.

VACUUM FORMING—Now in its third printing, the most comprehensive book on vacu-forming ever published for the hobbyist. 128 pages of hands-on information show how easy it really is to make your own plastic parts. Includes exclusive information on an easy-to-build 2-stage vacuum system for truly professional results. It's easy! Try It! $9.95 + $1.05 postage. Vacuum Form, 272B Morganhill Dr., Lake Orion, MI 48360; (800) 737-3000. $1 surcharge for Visa/MC. [10/95]

WANTED: Model engines and race cars before 1950. Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [6/94]

WANTED: your old proportional radios; interested in pre-1980, American made; C&S, Deans, Klinetronics Spar and others. Older is better. Ron Gwara, 21 Circle Dr., Waverly, NY 14892; (607) 565-7486. [9/93]

WANTED: Old, unbuilt, plastic model kits. Planes, military, figures, cars, promo. Aircraft or missile desk models. Send list, price. Models, Box 863, Wyandotte, MI 48192. [9/93]

ANTIQUE IGNITION AND GLOW PARTS CATALOGUE: 100 pages—timers, needle valves, original cylinder heads, point sets, drive washers, stacks, spark plugs, plans. Engines: Atwoods, Baby Cyclones, McCoys, Hornets, others. $8 postpaid, U.S.; $20 foreign. Chris Rossbach, R.D. 1 Queensboro Manor, Box 390, Gloversville, NY 12078 [8/93]

MAGAZINE BACK ISSUES—Flying Aces, MAN, Air Trails, 1930s and '40s. FM, RCM and more. Send SASE for list to: Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [8/93]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [10/93]

WANTED: model airplane engines and model race cars made before 1950. Jim Clem, 1201 E. 10, P.O. Box 524, Sand Springs, OK 74063; (918) 245-3649. [6/93]

WANTED: Built or partially built Ercoupes, Mooney M-10 Cadets, or Cessna 150, 152, 172, 182. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; (714) 768-0585. [10/93]

CAD-DESIGNED, Space Shuttle mailbox prints—$14.86; ceramic jumbo-jet birdhouse—$24.95. Hangar 18 Reproductions (Dept. ma), P.O. Box 153, Chelsea, OK 74016. [8/93]

PLANS ENLARGED—Scanning/plotting services; CAD/printer plotter software. Free information. Concept, P.O. 669E, Poway, CA 92074-0669; (619) 486-2464.

125 Plus kits for sale. Balsa plastic tools, list $1. Denhoff, 787 Pawnee, Carol Stream, IL 60188. [9/93]

NONE BETTER in the universe! The best VHS flight-instruction tapes available anywhere! Silicon Valley R/C Technologies: (800) 822-1500. [9/93]

SCALE AIRCRAFT DOCUMENTATION and RESOURCE GUIDE. World's largest commercial collection. Over 4,000 different color Foto-Paaks and more than 22,000 three-views. Catalogue—$5 ($10 foreign). Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [8/93]

P/C—THE EASY WAY to simulate metal panels; $1 gets information and sample. Clarke Smiley, 23 Riverbend Rd., Newmarket, NH 03857. [12/93]

1930s to 1950s MODEL AIRPLANE MAGAZINES—1930s aviation pulps—complete and in good condition; $1 for list. Bruce Thompson, 328 St. Germain Ave., Toronto, Ontario, Canada, M5M 1W. [12/93]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $2 for large list to Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [11/93]

LOCKHEED P-38 LIGHTNING—Are you a P-38 Lightning fan?—R/C models or full-size? Join the P-38 Model Organization International! For more information, send $1 to the P-38 Model Organization International, Medelbyvej 54, 2610 Rodovre, Copenhagen, Denmark [8/93]

MAKE REAL DECALS with your computer and printer! Send $10 for starter kit and instructions to LABCO, 27563 Dover, Warren, MI 48093-4764. [10/93]

MISSILE SECRETS—engines, rockets, U-build. $2. Northtech-A5, 813 Cherry Ave., Albany, GA 31710 [7/93]

FOR SALE—Kits-aircraft. Plastic, wooden, all pre-1965, parts, magazines. Send SASE for list to: Leonard Roberts, 3819 Lydon Ln., Moosic, PA 18507; (717) 961-2357. [7/93]

ON BOARD GLO-DRIVER KITS. 'Hot Wire,' the built-in Glo-driver—a must for all glow-type engines; for safer, easier starts, reliable idles, positive engine kill, better fuel economy, cleaner aircraft. Order kit #101 for single cylinder engines, $19.95 + $4 S&H or kit #102 for twin cylinder engines, $29.95 + $4 S&H to: E&T Enterprise, P.O. Box 1901, Kitty Hawk, NC 27949. [8/93]

CARBON FIBER, 100 ft. 12k tow—$9.95 plus $2 S&H, for information send SASE to: DISCOUNT COMPOSITES, P.O. Box 96, Bountiful, UT 84011-0096. [11/93]

HELICOPTER SCHOOL-5 days of hands-on instruction with X-Cell helicopters and Futaba computer radios. Small classes tailored to your individual needs. Beginner to expert. Includes all meals and lodging. Over 225 satisfied students and 7,500 flights logged. Located on a 67-acre airport used exclusively for R/C training; owned and operated by Ernie Huber, five-time National Helicopter Champion and helicopter designer. Send for *free* information and class schedule *now!* R/C Flight Training Center, P.O. Box 727, Crescent City, FL 32112-0727, or call (800) 452-1677. Outside USA: (904) 698-4275, or Fax (904) 698-4724. [9/93]

SCALE DOCUMENTATION: PLAN ENLARGING. 140 Super-scale, Sport and Giant R/C construction plans, three views, cutaway drawings. More than 100,000 documentation photos in stock. 120-page catalog $5 ($10 air overseas). Jim Pepino's Scale Plans and Photo Service, 3209 Madison Ave., Greensboro, NC 27403; (919) 292-5239. Visa/MC. [4/94]

JET ENGINES—pulsejets, Jet-X, Turbonique. Monthly newsletter $12/yr; $20 international; single issue $2. Catalog $5. DOYLEJET, P.O. Box 60311-A, Houston, TX 77205; (713) 443-3409. [7/93]

R/C WORLD-ORLANDO, FL—Condo for Sale: 3 bedrooms, 2 baths, multi-acre flying field, enclosed hangar, swimming pool and tennis on site. Minutes from Disney and Epcot Center. Call Tom at Prudential Florida Realty; (407) 260-0057.

MONTHLY R/C SWAPMEET delivered to your door! Nationwide buy/sell/trade newsletter with quick turn-around. Free sample copy and ad coupon. R/C Trader, P.O. Box 145, Big Lake, MN 55309; (612) 295-7521. [7/93]

WANTED: Old engine parts, misc. junk before 1970. Wesley Pettinger, 1501 Banbury Ct., Richardson, TX 75082; (214) 669-4003. [7/94]

CUSTOM KIT BUILDING—Will build most kits from trainers to quarter scale. 20 years experience. Write for quotes, Midwest Model Factory, 280060 Highland Rd., Minatare, NE 69356. [9/93]

FOUR 1993 SCALE CATALOGS. SPPS superscale plans, SPPS scale documentation, ASP scale plans handbook, ASP aircraft scale drawings handbook (3 views). Catalogs $5 each. Overseas air, add $5. 1-4 catalogs. 140 different scale plans, 120,000 photos. Jim Pepino's Scale Plans and Photo Service, 3209 Madison Ave., Greensboro, NC 27403; (919) 292-5239, Visa, MC. [4/94]

GIANT-SCALE GERMAN AMPHIBIAN AND FLOAT-PLANE PLANS. Northrop Gamma, Aeronca I.B., Bush Planes. Two stamps for catalog. Gene Falada, Sea-Clusion Aeronautics, 22W 070 Byron, Addison, IL 60101. [9/93]

BUILDING BIG BIRDS—Ace, Hots, Lanier, Ohio R/C and Sig kits. Bare bones to completely finished RTF; high-quality workmanship; reasonable rates. Call or write for quotes. Tracey Products, 113 High St., New London, OH 44851; (419) 929-8308 (after 5 p.m). [8/93]

PC-PERFORMANCE. Easy to use, menu-driven computer program predicts flight performance of R/C model aircraft. For IBM PC compatibles with monochrome or color graphics capability. Introductory price $15 + $3 S/H. Specify disk format. Softair, 10710 Evergreen Way #D305, Everett, WA 98204. [8/93]

R/C FLIERS DREAM COME TRUE. Vacation with your family, and bring your R/C plane! R/C World is a radio-control community with beautifully furnished condo (pool, tennis included), and one of the world's finest flying sites. All this only 20-30 minutes from Disney, Epcot, Universal Studios, Seaworld, and about 1 hour to Kennedy Space Center. For more information, call or write: Dave Patrick, P.O. Box 1385, Oak Park, IL 60304. (708) 771-6697. [1/94]

ROCKETS! Make your own "solid fuel" rocket engines! Homemade fuels using potassium nitrate, sulfur and charcoal. From bottle rockets to over 100 lbs. thrust! Easy-to-follow, step-by-step videos, manuals and books show you how! Plus "PYROTECHNICS" Make M-80s, 1/4s, etc. Chemicals, supplies, catalog $3. Pyroteck, P.O. Box 1, Catasauqua, PA 18032, (717) 256-3087. [7/94]

R/C HELICOPTERS SERVICES: Professional building, repair, and set-up of all major helicopters and equipment. From beginner to pro. Need assistance or have no time to set up that machine? Call (516) 621-5903, Chris Marici, P.O. Box 351, Roslyn Heights, NY 11577. Conveniently located on Long Island. UPS and Fed-X shipping available. [8/93]

CLEVELAND KITS (AND PLANS) WANTED: Immediate cash, call or ship for offer. Ship to Jay Herbert, P.O. Box 1286, Mattituck, NY 11952. Phone (516) 298-4135 or Fax (516) 298-4181. [9/93]

DISPOSAL–Over 50-year aviation collection: slides, photos, negatives, three-views, documentation material. No list; sent wants and SASE to Dustin Carter Aviation, P.O. Box 2114, Valley Center, CA 92082; (619) 742-1783. [7/93]

FUN FLY HOTS® now in full kit form. Includes pre-cut parts. Fults gear accessory package. See Feb. '93 *Model Airplane News.* Video Tape (VHS) flying and construction. $49.95 + S&H. Dan Santich Models, RT 2 Box 293, Pinnacle, NC 27043; (919) 368-4414. [9/93]

WANTED—World War II and postwar recognition models. Old toy airplanes, cars, trucks, Zepplin, etc. Bill Fornwalt, 103 Dartmouth Ave., Johnstown, PA 15905. [11/93]

FOUR 1993 SCALE CATALOGUES—SPPS super-scale plans; SPPS scale documentation; ASP scale-plans handbook; ASP aircraft scale-drawings handbook (three-views); 140 different scale plans—120,000 photos. Catalogues—$5 each; overseas airmail, add $5 (1 to 4 catalogues); Visa, MC. Jim Pepino's Scale Plans and Photo Service, 3209 Madison Ave., Greensboro, NC 27403; (919) 292-5239. [4/94]

IMPORTED DIESEL ENGINES—world's best selection: AE, AM, Aurora, Cipolla, KMD, MAP3, Mikro, MK-17, MVVS, Modela, PAW, Pfeffer, Letmo and USE diesels, plus very special imported glow engines, CO_2 motors and sailplane kits. Ten-page catalogue—$1. Carlson Engine Imports, 814 E. Marconi, Phoenix, AZ 85022-3112.

WANTED—un-built monogram Speed-E-Bilt kits from the 1950s—particularly a Stearman. John Gorday, 624 Concord Rd., Pelahatchie, MS 39145. [10/93]

BOOKS—"Tailless Tale"—tailless aircraft for modelers: $38; "Structural Dimensioning of Radio-Guided Aeromodels"—building strong and light: $18; "On the Wing...The book"—tailless R/C sailplanes: $28. Orders or information: B2 Streamlines, Dept. A, P.O. Box 976, Olalla, WA 983 [10/93]

FOR SALE—Schluter JR50 heli with O.S. 50H, Futaba Super-7H radio, Futaba gyro, spares and blades. Less then 20 hours on the engine. Never flown with Super-7 radio. Asking $550, or best offer. Concept 30SX with O.S. 32H, Airtronics 6CH FM heli radio, Futaba gyro and spares. Less than 12 hours flight time. Asking $300, or best offer. Contact John Deluca, 8811 Colonial Rd., Brooklyn, NY 11209; (718) 745-7532. [8/93]

WANTED: control-line profile kits—Midwest P-63, Skyraider, P-51, ME-109, Sterling Navion, Starfire, Skyshark P-40, ME-109, Ringmaster Sportster, Goldberg Cosmic Wind, Buster, thee-line Bellcranks, Roto-Valve, McCoy 19/35 red/blue, K&B 19/35 green, Dynamic 19/60 throttles, McCoy 19/19RC red/blue, engines. Paul Patterer, 114 Mosher Ave., Battle Creek, MI 49017; (616) 965-5364. [8/93]

CUSTOM KIT CUTTERS—your plans or anyone else's. Ask about our special price for the 53-inch Nottorsale; 1/4-scale, 84-inch Nottorsale; and our custom 1/4-scale G-Shark. Ask about our other kits and ARFs. For info, call (609) 448-1122. Orders only, call (800) 645-KITS. [10/93]

ATTENTION! Model Aircraft Sale—1/3-scale Weeks special with Saito 300 smoke: $1,800; 1/4-scale Pitts special set up for G38 with smoke: $1,000; Scorpio Taurus with O.S. 120: $700; 1/5-scale Beaver on floats set up for O.S. 160/120: $550; two, 1/4-scale Sig Cubs—one on floats, one set up with G23; Sig King Cobra with Airtronics plus O.S. 61 with pipe: $700; Schluter Whopper with servos, plus O.S. 61 with pipe $500; Lanier Stinger with G62 smoke servos: $900; Byron Christen Eagle kit with decals: $300. Call Kelly at (916) 961-0514.

NEW ZEALAND AERO PRODUCTS—Scale plans: Agwagon, Pawnee, Pawnee Brave, Airtruk/Skyfarmer, Fletcher FU-24, Aerobat, Hall's Springfield Bulldog, Typhoon, DC-3/C-47, Fairchild PT-19/Fleet PT-26 and more. Fiberglass parts; hardware packs; timber packs; color photo packs available. Free documentation with plans. Catalogue/price list: $5 (U.S.); Visa/MasterCard. 34 Ward Parade, Stirling Point, Bluff, New Zealand; (03)2128192.

FREE—Tesla turbine plans. Contact Dan, 1214 N, 6th St., Port Hueneme, CA 93041. [8/93]

MAGAZINES—*Model Builder* 71/91, $150; *American Modeler* 56/68, $75; *American Aircraft Modeler* 68/75, $30—plus shipping. George Wilson, 82 Frazier Way, Marstons Mills, MA 02648. [8/93]

WANTED—KRAFT KP-4/6 from 1964-66. Karlheinz Schmid, Stieranger 7, 8900 Augsburg 21, Germany. [12/93]

CLUB OF THE MONTH

SIMI VALLEY FLIERS
P.O. BOX 3343, SIMI VALLEY, CA 93063

"The Flier," the newsletter of the Simi Valley Fliers Club in Simi Valley, CA, consists of 26 well-organized pages and reads more like a weekly newspaper. This paper, though, reports on the minor and major concerns of the radio-control world. Founded in 1963, the club now has 175 senior and 23 junior members. The Simi Valley Fliers enjoy the use of an 8-acre flying field leased long-term from the county. A paved runway and a pit area have been installed. Besides its facilities for powered models, the club has also developed an area where gliders can be flown with either thermal or high-start launches.

Making the best use of both areas and the airspace, powered fliers fly from 7:30 a.m. until 2 p.m., and the glider guiders fly after 2 p.m. (they also take advantage of a regular westerly wind that kicks up at this time). The club is host to many activities, including pattern contests, Fun-Flys, Giant-Scale meets, Glider Fun-Flys, club BBQs and a Christmas dinner dance; they even sponsor a float in the community's annual parade. The club also encourages junior members to become involved in community.

One unusual event is a Construction Derby. This event gives the contestants 90 minutes to construct an R/C airplane and then fly it through 12 different maneuvers (safely!). Prizes are awarded for the three best team efforts.

All this, along with a 12-month calendar of events; regular columns; photos; comments from the officers and committee members; and form letters to be sent to the FCC and the Senate regarding FCC Proposed Rule Making NPRM PR Docket 92-2135 bring the entire scope of the club and its activities to the reader.

For its continuing work to help R/C grow and its involvement with its community, *Model Airplane News* is sending the club two free subscriptions.

AIRWAVES

(Continued from page 126)

in recent times. Giant-scale racing is a category of motor sport, and each Madera race could be the stuff of several articles, or even a book. We will continue our efforts to provide the best event coverage in the modeling media, and this will include a look at the construction of one or more top models in both the Unlimited and AT-6 Texan classes. Readers who want more information on the '93 races, or who would like to obtain an excellent video depicting the '92 Madera Unlimited races, can contact Lesley Burnett or Nancy Bridi of Endless Horizons Inc., P.O. Box X, Torrance CA, 90507; (310) 320-8369. GY

PC PRACTICING

I've been reading your magazine for several years, but I don't remember ever seeing any review on the Dave Brown Flight Simulators for PCs. Knowing that you do quite a bit of testing and evaluating of different products, I was hoping that somebody would be familiar with it. I'm thinking about buying one, but I hate to make the investment without finding out more. I'd also like to know whether I'll need one game port or two.

DON PRINGLE
Mayville, WI

Don, the R/C Flight Simulator has been around for quite some time now. We reviewed the first version about five years ago, and every owner I have talked to has felt it has been a worthwhile, useful program. "Model Airplane News" is currently testing the latest 3.2 version, and our test results will be published in the near future. This program only calls for one game port; both joysticks are wired into it. CC

ADVERTISER INDEX